

5-2007

Assessment of Hydration Knowledge, Attitude, Behaviors and Fluid Replacement Effectiveness of Collegiate Athletes.

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ASSESSMENT OF HYDRATION KNOWLEDGE, ATTITUDE, BEHAVIORS
AND FLUID REPLACEMENT EFFECTIVENESS
OF COLLEGIATE ATHLETES.

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Human Nutrition

by
Jeffie Elisha Trammell
May 2007

Accepted by:
Dr. Elizabeth Kunkel, Committee Chair
Dr. James Rieck
Dr. Thomas Jenkins

ABSTRACT

The purpose of this study was to determine what collegiate athletes know about hydration, how they feel about what they know, and how they behave in regards to staying hydrated. In addition, this study also sought to monitor how well athletes stay hydrated during intense preseason training and to determine if there was any significant correlation between what they knew and how well they maintained their level of hydration. A total of 74 athletes completed the survey to assess their knowledge, attitude and behavior regarding hydration. Of those 74, 59 also allowed monitoring of their hydration status using weight charts. The mean age of the athletes participating in this study was 19.7 ± 1.4 years. The mean score for the entire survey was 115.54 ± 10.79 and the mean scores for the knowledge, attitude, and behavior sections were 17.54 ± 1.91 , 84.01 ± 9.01 , and 13.98 ± 2.71 respectively. Significant differences in knowledge scores ($P < 0.05$) were noted between sophomores (18.0 ± 0.9) and seniors (16.7 ± 3.2), and those who listed their training intensity as high (18.1 ± 1.3) and very high (17.3 ± 1.4). There were no significant differences noted among any of the demographic variables for the attitude section of the survey. There were significant differences noted between some of the demographic variables for the behavior scores. Both the men's soccer team (15.00 ± 2.00) and the women's soccer team (14.92 ± 2.27) scored significantly higher on the behavior section than did the men's cross country team (12.00 ± 2.75) and the women's cross country team (10.28 ± 2.87). In addition, the football team (13.45 ± 2.50) also scored significantly higher than did the women's cross country team (10.28 ± 2.87). Significant differences in behavior score were also noted

between those athletes who said they use fluid supplements (15.26 ± 1.93) and those who don't (13.54 ± 2.81), and between those athletes who listed their intensity as moderate (11.37 ± 2.66) and those who listed their training intensity as high (14.61 ± 2.48) and very high (13.94 ± 2.61). There were no significant correlations between any of the survey scores and any of the weight chart data. The athletes did well on the survey and appear to be very knowledgeable about general hydration information. However, there does not appear to be a strong relationship between knowledge and practice related to hydration. Based on the results of this study, allied health care professionals continue to need to monitor athletes and how they maintain their hydration status.

DEDICATION

I would like to dedicate this work to my family. Without their help and support over the past 24 years of my life none of this would have been possible. They have opened doors for me and have enabled me to do things that bring me joy in my life. I am forever indebted to all of them for the love, assistance, and guidance they have provided for me.

ACKNOWLEDGMENTS

First I would like to acknowledge Philip E. Nichols, Satya S. Jonnalagadda, Christine A. Rosenbloom, and Marvin Trinkaus for allowing me to use the survey the constructed for their study Knowledge, Attitudes, and Behaviors Regarding Hydration and Fluid Replacement of Collegiate Athletes for my study. Without their help this research would have been much more complicated than originally thought. In addition I would also like to acknowledge Coach Tommy Bowden, Coach Trevor Adair, Coach Todd Bramble, Coach Marcia Noad, Coach Bob Pollock, and Coach Jolene Jordan-Hoover for allowing me to use some of their valuable time to get these surveys completed. I would also like to acknowledge Danny Poole, Donna Bullock, Raz Razayeski, Robbie Stewart, and Stacey Hitzelberg for allowing me to work on this thesis in the athletic training room and in assisting me in collecting data. I would also like to thank all of my fellow graduate assistant athletic trainers, Pat Hassel, Andrew Crews, Gwendolyn Davis, Jennifer Bell, Laura Schnettgoecke, Lindsay Melnyk, Michael White, Nick Kulick, Rachel Geoghegan, and Rebekah Helton. These people have helped me collect data and have helped me with work so I could complete this study. I would also like to thank Dr. Beth Kunkel, Dr. James Rieck, and Dr. Tom Jenkins for allowing me to take up so much of their valuable time so that this study could be completed. I have worked on this study for a long time but I would be foolish to take full credit, because without the help of the people listed above this study would not have been possible.

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CHAPTER ONE INTRODUCTION

In order for collegiate athletes to perform and train at their highest level it is crucial that they are properly hydrated. However, athletes continue to participate in competition and training in a dehydrated state (Finn et al., 2004). Ignorance of the importance of hydration; availability of fluids before, during, and after participation, and belief in misinformation about hydration are possible reasons for the lack of proper hydration (Nichols et al., 2005).

The purposes of this study were to gain an understanding of how well athletes hydrate themselves for training and competition and what they perceive it takes to be properly hydrated. There are several ways to monitor hydration, such as assessing plasma volume, urine specific gravity, urine color, and weight loss. For the purpose of this study, weight loss was used to monitor hydration by having athletes weigh in before and after participation in training. The weight loss during participation is mostly fluid loss so it is important for athletes to replace that fluid loss by the next practice or event. By monitoring weight loss, an athlete can see approximately how much fluid they need to drink before the next practice or event. In this study the athletes' ability to replace the fluid lost was used to determine how well hydrated they are. The athletes' perception of their own hydration and knowledge of hydration was measured using a survey.

The weight loss and survey data was gathered during preseason training at a NCAA division I institution. The study included athletes participating in football, men's soccer, women's soccer, women's volleyball, men's cross country and

women's cross country. The surveys were administered once at a team meeting prior to the beginning of preseason training. Those athletes who completed the survey were then asked to weigh before and after each training session. The survey used for the study was modified from Nichols et al. (2005). Having the athletes weigh before and after training enables them to monitor their fluid loss and have an estimate of the amount of fluid they need to replace prior to the next training session. This information was used for monitoring fluid replacement and for comparing adequacy of hydration with knowledge and admitted behaviors regarding hydration.

The hypothesis of this study is that athletes do not adequately hydrate themselves for competition and training and that they lack an understanding of proper hydration.

CHAPTER TWO REVIEW OF LITERATURE

Hydration is an important but often forgotten aspect of nutrition. The body is sixty percent water, so adequate hydration is a significant part of nutrition.

However, as with all aspects of nutrition, circumstances may arise that will alter the needs for a nutrient. Age, activity level, climate, and altitude can influence the fluid needs of an individual and increase risk for dehydration (Grandjean et al., 2004).

Dehydration is the result of not meeting fluid needs and can lead to headache, coma or even death (Casa et al., 2000).

The two main water compartments in the body are the intracellular compartment and the extracellular compartment (Grandjean et al., 2004). Total body water is, on average, 60% intracellular and 40% extracellular (von Duvillard et al., 2004). Blood plasma, lymph, saliva, fluid in the eyes, fluids secreted by glands and the digestive tract, fluid that surrounds the spinal cord, and fluid excreted by the skin and kidneys are all considered extracellular (Grandjean et al., 2004). Twenty percent of this extracellular fluid, or approximately three to four liters, is blood plasma. The fluid lost in sweat is mostly extracellular fluid, coming predominantly from the blood plasma (McCardle et al., 1996).

The importance of water in the body cannot be overstated. If an individual goes without water for only a few days they will die. Water functions as the body's transport medium, helping to move other nutrients and substances throughout the body. Water also functions as the body's reactive medium (Grandjean et al., 2004). The diffusion of gases in the body would not be able to take place without water, because water moistens the surfaces across which the gases diffuse (McCardle et al.,

1996). The body also disposes of waste products using water in urine and feces (Grandjean et al., 2004). Water also helps to lubricate joints (McCardle et al., 1996).

One of the most important functions of water in the body is temperature regulation. Water is able to assist in this function of the body in part because of its high specific heat. The specific heat of water is one, which means that it takes one calorie of heat to raise the temperature of one gram of water one degree Celsius. The average 70 kilogram man contains 42 kilograms of water. This helps the body have a specific heat of 0.83, meaning that it takes 58 kilocalories to raise the body temperature one degree Celsius. The fluidity of water combines with the high specific heat to also assist the body in transferring heat from areas of production to areas of dissipation with only a minimal increase in blood temperature. One of the ways water helps to dissipate heat is through sweating; this is accomplished because water has a high heat of vaporization. When a gram of sweat evaporates from the skin, the body loses 0.58 kilocalories of heat (Senay, 1998). This process helps the body to cool itself when core temperature begins to rise.

The adequate intake for water has been set at 3.7 liters per day for men and 2.7 liters per day for women (Institute of Medicine, 2004). Water is easily obtained in the United States of America so the ability to meet the body needs of water is simplified since all beverages contain water, as well as most foods. However, some beverages such as alcohol act as a diuretic and contribute to water loss. The body also generates water during metabolic reactions to contribute to the water needed.

Water is lost naturally through the body via urine, sweat, vapor from the lungs, and feces. Climate and activity level can influence the amount lost through each individual avenue, but, on average, a sedentary person will lose between 1050 to

3100 milliliters of fluid per day and an athlete will lose between 1550 to 6730 milliliters of fluid per day (Sawka et al., 2005). By increasing water intake the urine concentration is diluted and the holding time in the bladder is diminished, which may help to decrease the risk of bladder cancer. In addition, sufficient water intake can also protect against kidney stones, prostate cancer, and breast cancer (Whitney et al., 2005).

Along with the ingestion of fluids, another important aspect of proper hydration is ingesting and maintaining the proper quantities of electrolytes. When electrolytes are present in the fluids that are ingested the body is able to do a better job of maintaining plasma volume. Keeping electrolytes present in the fluids an individual ingests also helps to promote voluntary fluid consumption. If only plain water is ingested there is an associated drop in plasma osmolality and sodium concentration, which in turn reduces the thirst mechanism (Shirreffs, 2004). Ingesting too much fluid without electrolytes can lead to hyponatremia.

Sodium is the most prevalent ion in the extracellular fluid, so sodium is lost more than any other electrolyte in the sweat. This sodium should be replaced to help maintain plasma volume. Glucose absorption in the small intestine is stimulated by sodium via the active co-transport of glucose and sodium, which also creates an osmotic gradient that helps promote water absorption (Shirreffs, 2004). For sedentary individuals the majority of their sodium is lost through urination. If sodium concentration becomes too low the kidneys will retain sodium, and if sodium concentration becomes too high the kidneys will excrete sodium (Kenney, 2004).

The average American consumes between eight to twelve grams of table salt per day, which is about 20 to 30 times the amount of sodium needed to replace the

obligatory losses (Kenney, 2004). The adequate intake for sodium is set at 1.5 grams per day, with an upper limit set at 2.3 grams per day. (Institute of Medicine, 2004) However, the Institute of Medicine acknowledges that these levels may not be adequate for someone who is physically active and has a lot of fluid loss through sweat.

The most important ion in the intracellular fluid is potassium. However, the role of potassium in retaining water in intracellular fluid is not as important as the role of sodium in retaining water in extracellular fluid (Shirreffs, 2004). There is not a significant loss of potassium through sweat; potassium concentration in sweat will rarely exceed ten mmol per liter. However, those who are physically active and lose large amounts of fluid through sweat may need to increase their potassium intake to account for this excessive loss (Kenney, 2004). The Institute of Medicine sets the adequate intake for potassium at 4.7 grams per day (Institute of Medicine, 2004) and in most Americans these values are not met (Kenney, 2004).

Another electrolyte that is lost through the sweat is magnesium. Although not as important as sodium or potassium, a reduction in plasma magnesium concentrations may lead to muscle cramps. However, this drop in plasma magnesium concentration is more likely due to the redistribution of compartmental fluid than to sweat loss. Therefore, there does not appear to be a need to replace magnesium via fluid ingestion (Shirreffs, 2004). The best strategy for ingestion of electrolytes is to eat a balanced diet, monitor fluid loss through sweating, and consider ingesting fluid with added electrolytes.

With increased exercise, there is an increase in both plasma and red cell volume (Convertino, 1991) During exercise fluid is lost from the vascular volume.

This decrease in vascular volume will in turn increase the plasma concentration of certain hormones that are directly concerned with fluid and electrolyte balance. These hormones include aldosterone, anti-diuretic hormone, and atrial natriuretic peptide (Rocker et al., 1989). The increase in aldosterone and anti-diuretic hormone help the body to retain sodium and water which accounts for the initial increase in plasma volume after physical activity. Another factor contributing to the reduction in plasma volume during exercise is the osmotically active ions produced by muscular contractions, which cause water to move out of the vascular volume (Senay, 1998).

The obvious loss of fluid during physical activity comes from sweating. The body dissipates heat via convection and radiation. When these two means of heat loss are insufficient in preventing an elevation in body temperature, there is an increase in blood temperature (Casa, 1999). This increase in blood temperature flows through the anterior hypothalamus and stimulates the appropriate neurons to initiate sweat gland activity. The sweat spreads over the body's surface and evaporates into the atmosphere; this evaporation of sweat removes heat from the body's surface, thus cooling the body. The water used to form sweat is most readily accessible via the interstitial space, although it is apparent that each sweat gland is served by several capillaries. This interstitial fluid makes up around 55% of the water lost in sweat, with plasma contributing around 10%, and the other 45% coming from the intracellular volume (Senay, 1998).

The water lost through sweating reduces plasma volume, which in turn increases the concentration of red blood cells and the viscosity of the blood. This lowers the ability of the body to adequately supply the muscles with oxygen and to

move a sufficient amount of blood through the vascular system thus compromising body cooling. This causes the heart to work harder to move the same amount of blood, hence the increased heart rate. There is also an associated reduction in blood flow to the kidneys causing the formation of urine to decrease (Senay, 1998).

With all physically active populations there is a concern with performance. Those who participate in athletics want to perform at their optimal level. One way to help these people to reach their peak performance is to make sure they are properly hydrated. It is easy for athletes to become dehydrated because of the consecutive bouts of exercise they perform (Casa et al., 2000). Fluid, electrolyte, and compartmental losses increase as the duration and intensity of exercise increase (Rehrer, 2001). Loss of even one percent of body water can lead to a decreased ability to perform a set task (von Duvillard et al., 2004). Coyle and Montain (1994) reported that increases in core temperature and heart rate can be diminished by drinking fluid to replace that lost through sweat. In fact, the greater the percentage of fluid loss replaced, the less the increase in core temperature and heart rate and the lower the perceived exertion.

Decreases in muscle strength can occur at levels of 5% dehydration. In addition to decreased muscle strength, there is also a decrease in muscle endurance with dehydration levels as low as 3% and 4%. There is also an associated decrease in maximal aerobic power at dehydration levels of 3% (Casa et al., 2000).

Exercising in the heat can make it difficult to perform optimally, but not being prepared to exercise in the heat can lead to serious medical conditions even death. The body temperature rises due to both the exercise and the energy that is wasted as heat. When the environment is cool the body is able to transfer most of

the heat to the cooler air, but this transfer is diminished when the environment is hot. In fact, the body takes on more heat (Maughan, 1997). When exercising in the heat the cardiovascular system cannot simultaneously meet the demands of skin and muscle. Maintenance of blood pressure takes precedence which places the body at risk for hyperthermia because blood flow to the skin is diminished. For an athlete or physically active individual to perform consistently, they must be able to match heat gain with heat dissipation. This becomes difficult in especially humid environments when the sweat produced is unable to evaporate and cool the body (Casa, 1999).

Heat illness is a serious and sometimes deadly condition that can result from not being properly hydrated. Heat illness is the third leading cause of death among all high school athletes in the United States. Although dehydration is the most prevalent and easily corrected risk factor for heat illness there are others that should be considered. Obesity, low physical fitness, lack of acclimatization, previous history of heat illness, sleep deprivation, medications, sweat gland dysfunction, upper respiratory or gastrointestinal illness, and climate are all risk factors for heat illness (Coris et al., 2004). The best way to battle the onset of heat illness is to ensure proper hydration before and during activity. The first step in ensuring proper hydration is providing education on the risks of heat illness and on maintaining and monitoring hydration status. The next step is to ensure that participants are drinking enough before and during activity. Finally, participants should know what to do to ensure adequate rehydration.

Fluid needs during activity in the heat can reach levels of 10 liters or more (Murray, 1998). It has been recommended that athletes consume an additional 500 milliliters of fluid 2 hours before activity (Coris et al., 2004). When it is especially

hot, athletes may be advised to drink an additional 250 to 500 milliliters of fluid 30 to 60 minutes before exercise (Murray, 1998). Athletes should also be educated on types of fluids to drink and what kinds of fluids to avoid. For the most part before activity athletes should consume sports drinks, water or fruit juices and should avoid caffeinated and alcoholic beverages due to their diuretic effect. It is also important for the athletes to have easy access to fluids before activity (Casa et al., 2000).

Fluid requirements for cold environment are the same as those for temperate climates. Being dehydrated in the cold can lead to a decrease in the efficiency of resistance to cold weather (Askew, 1998). Sweating will not be a major source of fluid loss in cold climates. However, water is lost in the cold as water from the respiratory passages is vaporized as an incoming breath of air is warmed (Sawka et al., 2005). If this is coupled with diminished thirst mechanism in cold weather, dehydration can occur. Preparing for exercise in the cold is the same as preparing for exercise in the heat, with the consumption of an additional 500 milliliters of fluid 2 hours before participation and 250 to 500 milliliters of fluid 30 to 60 minutes before participation. Maintaining hydration during activity in the cold weather is also important. The best way to maintain hydration while exercising in the cold is to follow the same guidelines as exercising in the heat.

There is another aspect of hydration to consider, and that is rehydration. In some cases, there is need for additional fluid intake to replace the fluid and electrolytes lost. Plain water does not replenish electrolytes, especially sodium, lost through sweat (Maughan, 1996). The sodium and glucose in sports drinks help to replenish muscle glycogen as well as increase plasma volume and retain water (Puhl, 1998). Athletes can also prevent dehydration by monitoring their hydration status in

order to effectively re-hydrate themselves. One monitor of hydration status is weight loss. By weighing in and out before and after activity athletes are able to determine the amount of fluid needed in order to re-hydrate themselves properly (Godek, 2005). It is also important to realize the need to not only match fluid loss, but exceed fluid loss to account for the obligatory urine loss. For this reason it is suggested that a person should ingest 20 ounces of fluid for every pound lost during activity (Murray, 1998). In addition, Casa et al. (2000) suggest that in order to replenish the fluid loss an athlete should drink about 25%-50% more than they lost in order to account for fluid lost through urination. This would equate to 20-24 ounces for every pound lost during activity. Monitoring weight change during periods of intense training is an easy way for athletes to monitor their hydration status (Oppliger et al., 2002). However, just because an athlete replaces the fluid loss does not mean they are 100% re-hydrated. Plasma osmolality is not restored to baseline values when fluid ingestion matches a 5% loss in body weight and a 6% weight loss requires 48-72 hours to completely restore (Oppliger et al., 2002). Regardless of the limitations, monitoring body weight is an affordable, accurate, and universally accepted way of monitoring hydration status (Grandjean et al., 2003). Athletes can also be instructed to monitor the color of their urine to assess hydration status (Oppliger et al., 2002). If properly hydrated the athlete should be urinating several times a day (Wetherall, 2003) and the urine should be light in color and not have a strong odor (Cheuvront, 2005). A widely accepted and practical six point Likert color scale has been developed to aid in helping those look at the color of their urine to monitor hydration status (Oppliger et al., 2002). Although a large ingestion of fluids can mask hydration status when using the urine color method, it is

still an affordable and accurate way for athletes to monitor their own hydration status (Oppliger et al., 2002). Along with the ingestion of fluids, some athletes may try to re-hydrate after activity by receiving intravenous fluids. There is no benefit to this type of rehydration and maybe even some minimal detriment, yet it is still used by many (Casa, 1999).

Educating athletes on aspects of hydration is an important part of being an allied health care professional. Only about 20% of athletes consume sports drinks while training and 40% of athletes consume alcohol on competition day. Only 22% of collegiate athletes knew that sports drinks were a better fluid choice than water; which shows that some athletes lack a complete understanding of hydration (Nichols et al., 2005). By monitoring their weight, urine volume and urine concentration after activity athletes have solid guidelines to follow to ensure hydration.

Despite all of the evidence to support proper hydration, athletes continue to participate in training or competition in a dehydrated state. Finn et al. (2004) reported that 87% of athletes participating in an international competition for volleyball, basketball and touch football were in a dehydrated state. In addition, Nichols et al. (2005) found that 33.1% of the athletes they surveyed could not correctly answer 80% of the questions they were asked about general hydration knowledge, including questions on NATA and ACSM position statements on hydration. These guidelines set out in the NATA position statement include following hydration protocols, making drinks readily available, and making sure fluid replacement tries to match fluid loss through sweat and urine (Casa et al., 2000). However, athletes who understand the benefits of hydration on athletic performance were more likely to consume adequate fluid before dehydration occurs (Casa, 1999).

Athletes seek nutritional guidance from coaches, strength and conditioning staff, and athletic trainers. Of these groups athletic trainers were the most frequent source of nutrition information and were perceived to have good knowledge of nutrition (Burns, 2004).

CHAPTER THREE MATERIALS AND METHODS

This study was designed to measure the knowledge, attitude, and behavior of collegiate athletes regarding hydration and to monitor their hydration status.

Knowledge, attitude, and behavior were measured using a survey (Appendix A), and hydration status was monitored using weight charts. Survey scores were then compared to hydration status to determine correlation between the two.

Institutional Review Board approval was obtained prior to the start of this study and each athlete provided informed consent to participate in the study.

Football, men's and women's soccer, men's and women's cross country, and women's volleyball were all in preseason training at the time of the study. Every athlete on each of those teams was eligible to participate in the study. A total of 74 athletes completed the survey portion of the study, while only 59 documented their weights. The athletes who did not document their weights were unable to do so because of their practice sites and times, or because their coaches were not comfortable with them disclosing their weights to us.

The survey was modified from a previous study, which was based on position statements released by the American College of Sports Medicine and National Athletic Trainers Association (Nichols et al., 2005). Permission to use the survey was obtained from the researchers who designed the survey (Appendix A). The survey has two parts. The first part has 9 questions regarding demographic information. The second part of the survey assesses an athlete's knowledge, attitude, and behavior on hydration. Each section of the survey asked the same questions with different wording. The questions were in the same order in each section.

Those questions in the knowledge section were answered true or false, the questions in the attitude section were answered using a 5-point Likert scale (strongly agree to strongly disagree), and the questions in the behavior section were answered either yes or no. There are 20 questions in the knowledge section, 20 in the attitude section, and 18 in the behavior section. There are 18 questions in the behavior section because the Institutional Review Board asked that two questions be removed because they may ask about use of illegal substances. Three other questions were deleted from the original survey because they were not relevant to the present study.

Each correct answer in the knowledge section was given a score of 1 and each incorrect answer was given a score of 0, so the maximum score in this section would be a 20 and a minimum score would be 0. The questions in the attitude section were scored on the 5-point Likert scale with the maximum score on each question a 5 and the minimum score a 1. A maximum attitude score would be a 100 and a minimum attitude score would be a 20. The questions in the behavior section were scored 1 and 0, with 1 assigned to each correct answer and 0 assigned to each incorrect answer, so the maximum behavior score would be 18 and a minimum behavior score would be 0. An overall score of 138 would equal a perfect score on the survey. Surveys were scored using SAS version 9.1 for Windows (trademark). The questions that were answered correctly in the negative direction were inverted using SAS to make sure that scoring consistency was maintained.

During preseason training, many athletes monitor their weight loss using weight charts. These weight charts were used in the study to monitor rehydration by the athletes. Athletic trainers facilitate the use of these weight charts by making a scale available, posting the charts in the locker rooms, and reminding the athletes to

weigh in and weigh out. Permission to use the weight charts was obtained from the athletes in the informed consent form. There are missing data for some of the athletes when they failed to weigh. Weight charts were compiled during the preseason training for all of the sports except for men's and women's cross country. Men's and women's cross country abstained from participating in this part of the study due to practice location and coach's request.

Data obtained from the weight charts were the percent weight loss replaced between training sessions and percent weight loss per training session. Percent weight loss replaced was calculated by subtracting weight from after the first training session from weight before the second training session and dividing by weight loss from the first training session. The closer a number approaches 1 or 100% the better that athlete has done in replacing the fluid lost in a training session. A negative number means the athlete has lost weight between training sessions. The other number compiled from the weight charts was percent weight lost per training session. This number reflects, on average, fluid loss by athletes in a training session. This number was calculated by dividing amount of weight lost in a training session by the initial weight of the athlete. These numbers help identify which types of athletes are at a greater risk for dehydration because of inadequate fluid replacement or excessive fluid loss.

Data Analysis

SAS version 9.1 for Windows (trademark) was used to perform all the statistical analysis for this study. Frequencies for demographic information, such as gender, ethnicity, year in school, team, training duration, training intensity, supplement use, and prior education were determined. Means were calculated for

scores on each individual section of the test, age, percent weight lost in a training session, and percent weight replaced in between training sessions.

Cronbach's alpha was used to measure how well each section of the survey measured its respective latent construct (i.e. knowledge, attitude, behavior). A score of 0.70 is viewed as strong, which means that it does a good job of measuring its respective latent construct. The study from which the survey was modified had very strong Cronbach's alpha scores, 0.94, 0.92, and 0.96 for knowledge, attitude, and behavior, respectively (Nichols et al., 2005).

Analysis of variance was used to compare groups of athletes by their survey scores. Comparisons were made between males and females, year in school, team, training duration, training intensity, supplement use, and prior education. Level of significance for these tests was set at $P < 0.05$.

Finally, weight chart data and survey scores were combined to determine correlations.

CHAPTER FOUR RESULTS

Seventy-four athletes completed the survey and 59 athletes documented weights in the weight charts. Athletes from football, men's soccer, women's soccer, women's volleyball, men's cross country, and women's cross country participated in the survey, and all of these athletes documented their weights during preseason training with the exception of men's and women's cross country.

Cronbach's Alpha

The raw Cronbach's alpha scores were 0.19, 0.70, and 0.61 for knowledge, attitude, and behavior, respectively. The standardized scores for attitude and behavior were 0.76 and 0.64, respectively. There was no standardized score for the knowledge section. (Appendix C)

Demographic Information

There were 35 females and 39 males who participated in this study. The average age of the athletes in this study was 19.7 ± 1.4 years. The males had an average age of 20.1 ± 1.5 years while the females had an average age of 19.4 ± 1.2 years.

Along with age, athletes were asked to give their year in school. The answers for year in school were freshmen (1), sophomore (2), junior (3), senior (4), and 5th year senior (5). The mean number of years in school for all of the athletes was 2.6 ± 1.2 . The mean number of years in school for males and females was 2.8 ± 1.1 and 2.3 ± 1.2 , respectively.

The females included 26 women's soccer players, 7 women's cross country runners, and 2 women's volleyball players. The 39 males represented 11 football

players, 22 soccer players, and 6 cross country runners. Of the 74 athletes 56 were Caucasians, 13 were African-Americans, 3 were Latin-Americans, 1 was mixed, and 1 was other.

Forty-six of the athletes answered yes to a question as to whether they had any prior education on hydration before taking the survey, 27 answered no, and 1 athlete abstained from answering the question. In response to a question asking if they took any kind of supplement to help them stay hydrated, 19 answered yes and 55 answered no (Appendix B).

Athletes were asked how many hours they train a day on average during the preseason and to rate the intensity of these training sessions. The possible answers for training intensity were very low (1), low (2), moderate (3), high (4), and very high (5). The possible answers for training duration were less than 3 hours (1), 3-5 hours (2), 5-7 hours (3), 7-9 hours (4), and more than 9 hours (5). Mean training duration score was 2.28 ± 0.71 for all athletes, 2.45 ± 0.52 for football, 2.34 ± 0.68 for women's soccer, 2.54 ± 0.59 for men's soccer, 3.00 ± 0.00 for volleyball, 1.16 ± 0.40 for men's cross country, and 1.71 ± 0.48 for women's cross country. Mean training intensity score for all athletes was 4.35 ± 0.67 , 4.90 ± 0.30 for football, 4.57 ± 0.57 for women's soccer, 4.28 ± 0.46 for men's soccer, 3.00 ± 0.00 for volleyball, 3.50 ± 0.54 for men's cross country, and 4.00 ± 0.81 for women's cross country (Appendix B). There was a statistically significant difference in training duration among teams. According to the analysis of variance, the men's cross country team had a significantly shorter training duration than the football ($P < 0.0001$), volleyball ($P = 0.0004$), and both soccer teams ($P < 0.0001$). There were no statistically significant differences in training duration among the other teams. There were also some

statistically significant differences in training intensity among the teams. Football players rated the intensity of their training significantly higher than athletes from men's soccer ($P=0.0025$), volleyball ($P<0.0001$), men's cross country ($P<0.0001$), and women's cross country ($P<0.0001$). Women soccer athletes rated their training intensity significantly higher than athletes from volleyball ($P=0.0001$), men's cross country ($P<0.0001$), and women's cross country ($P=0.0134$). Athletes from volleyball rated the intensity of their training significantly lower than athletes from all other sports (Appendix B).

Knowledge

The maximum knowledge score recorded was 20 and the minimum knowledge score recorded was 6. The overall mean knowledge score was 17.54 ± 1.91 . Nine of the 74 athletes (12.16%) recorded a perfect score of 20. Questions 2, 5, 6, 7, and 8 were answered correctly by every athlete. These questions were related to signs of dehydration and whether one should drink fluids during training and competition (Appendix B).

Responses to questions 1 and 3 were most often answered incorrectly. Question 1, "Using salt tablets keeps athletes from getting dehydrated during training and competition" was correctly answered by 32 (45.1%) of the athletes, while 38 (52.1%) answered question 3 "Thirst is the best indicator of dehydration" correctly.

There were no significant differences between males and females on knowledge scores. Mean knowledge score for males was 17.3 ± 2.3 and the mean knowledge score for females was 17.8 ± 1.4 (Appendix B).

There were also no significant differences among the teams. Football had a mean knowledge score of 17.0 ± 1.7 , women's soccer had a mean knowledge score

of 17.9 ± 1.4 , men's soccer had a mean knowledge score of 17.4 ± 2.8 , volleyball had a mean knowledge score of 16.5 ± 0.7 , men's cross country had a mean knowledge score of 17.5 ± 1.4 , and women's cross country had a mean knowledge score of 17.7 ± 1.0 (Appendix B).

There were also no significant differences in knowledge scores between those who had prior hydration education and those who had not had prior hydration education. The mean knowledge score for those with no prior hydration education was 17.3 ± 2.6 , while the mean knowledge score for those who had prior hydration education was 17.7 ± 1.4 .

There were no significant differences in knowledge scores between those who used fluid supplements and those who did not. The mean knowledge score for those who use some kind of fluid supplement was 17.0 ± 3.0 and 17.7 ± 1.3 for those who did not.

The final demographic variable used to compare knowledge scores was class year. The only significant difference noted was between 4th year students (seniors) and 2nd year students (sophomores). The mean knowledge scores by class year were freshmen, 17.7 ± 1.3 ; sophomores, 18.0 ± 0.9 ; juniors, 17.7 ± 1.4 ; seniors, 16.7 ± 3.2 ; and 5th year seniors, 17.0 ± 1.0 .

There were no significant differences in knowledge scores associated with the different training durations, however, there was a significant difference in knowledge scores among the training intensities. Those athletes who listed their training intensity as high (18.1 ± 1.3) had a knowledge score significantly higher from those who said their training intensity was very high (17.3 ± 1.4).

Attitude

The maximum attitude score recorded was 96 and the minimum attitude score recorded was 30. The minimum score may be misleading as one athlete returned a survey in which an entire page of questions in the attitude section had not been answered. The next score above 30 was 67. No athlete achieved a perfect score (100) on the attitude section, and only 2 (2.7%) obtained the highest score of 96. The mean attitude score was 84.01 ± 9.01 . Since the attitude section was scored on a Likert scale it is not surprising that a perfect score was not obtained because although agree or disagree is technically a correct answer depending on the question a strongly agree or strongly disagree answer may be the more appropriate answer.

Most of the athletes answered questions 23 and 25 correctly. Question 23 “I believe if I experience nausea, headache, vomiting, or muscle cramps I may be dehydrated” was answered agree or strongly agree 98.65% (n=73) of the time while question 25 “I believe dehydration decreases my athletic performance” was answered agree or strongly agree 97.29% (n=72) of the time. Questions 22 and 36 were answered incorrectly most frequently. In response to the question, “I believe using salt tablets will keep me from getting dehydrated during training and competition,” 72.97% (n=54) of athletes answered strongly disagree, disagree or undecided and 53.42% (n=39) answered strongly disagree, disagree or undecided for “I believe when exercising for more than an hour, I should drink a sports drink rather than water.”

There were no significant differences in attitude score between gender, team, class year, training duration and training intensity. There was also no significant difference between those who had prior hydration education and those who did not,

as well as no significant difference between those who said they used fluid supplements and those who did not (Appendix B).

Behavior

The maximum score recorded in the behavior section was 18. This score was achieved by 5.41% (n=4) of the athletes. The minimum score recorded in the behavior section was a 6 recorded by only 1 athlete. In theory, someone achieving a high score on the behavior section would do an adequate job of staying hydrated. The mean behavior score was 13.98 ± 2.71 . Athletes did exceptionally well on questions 46, 47, 49, 50, and 57 with 95.95% (n=71), 95.95% (n=71), 94.59% (n=70), 90.54 (n=67), and 94.52% (n=69) answering correctly, respectively. These questions related to whether or not they drank fluids during practice and whether or not fluids were readily available during practice and competition. Question 46 was “I drink plenty of fluids so my athletic performance will not decrease due to dehydration”, question 47 was “I do not drink water or some type of fluid during practice”, question 49 was “Fluids are readily available to me during practice”, question 50 was “Fluids are readily available to me during competition”, and question 57 was “I use the color of my urine to determine if I am dehydrated.” Questions 55, 56, 58, and 59, were the questions that were missed with the most frequency. Thirty (41.10%) of the athletes missed question 55 “I drink at least 3.7 liters of water a day or 2.7 liters of water a day, for men and women respectively”. Question 56 “I drink sports drinks rather than water when competing for more than an hour” and question 59 “I use excessive sweating to warn me if I am getting dehydrated” were both missed by 43.84% (n=32) of the athletes. Question 58, “I weigh myself before and after practice to see how much weight I have lost from

sweating and use this to determine how much water or sports drink to consume”, was missed by 45.21% (n=33) of the athletes. Women’s soccer (14.92 ± 2.27) and men’s soccer (15.00 ± 2.00) had significantly higher behavior scores than men’s cross country (12.00 ± 2.75) and women’s cross country (10.28 ± 2.87). Football also had a significantly higher behavior score (13.45 ± 2.50) than women’s cross country (10.28 ± 2.87). There was also a significant difference in behavior score between those who said they use fluid supplements (15.26 ± 1.93) and those who do not use supplements (13.54 ± 2.81). Significant differences in behavior scores were also noted between the different levels of training intensity. The significant differences in behavior scores among the different training intensities were between those who said their intensity was moderate (11.37 ± 2.66) and those who said their intensity was high (14.61 ± 2.48) and very high (13.94 ± 2.61). There were no significant differences noted between gender, class year, and whether or not they had received prior hydration education (Appendix B).

Total Score

The highest total score on the survey was 131 or 94.92%, which was obtained by 1 athlete. The lowest score was 58 or 42.02%; however, one athlete submitted a survey with a page of questions not answered. The next lowest score was 95 or 68.84%. The mean total score was 115.54 ± 10.79 or 83.72%. There were no significant differences in total scores between gender, team, class year, education, supplements, training intensity, and training duration (Appendix B).

Weight Charts

There were no significant differences between gender, team, class year, training intensity, prior hydration education, and fluid supplement use for the mean

percent weight loss replaced. However, there was one significant difference in percent weight loss replaced between women soccer players who said their training duration was 5-7 hours per day and men soccer players who said their training duration was 5-7 hours per day. The mean percent weight loss replaced for the male soccer players was 104.66% and the mean percent weight loss replaced for the female soccer players was 41.93% (Appendix B).

There were also some significant differences noted between percent weight loss numbers among some of the demographic variables. There were significant differences in percent weight loss between class year, prior education, supplement use, and training intensity. There were no significant differences in percent weight loss found between gender, team, and training duration. There were also significant differences in percent weight loss noted among women's soccer players who use fluid supplements (3.3%), football players who do not use fluid supplements (0.7%), men's soccer players who do not use fluid supplements (1.2%), and women's soccer players who do not use fluid supplements (1.2%). The only significant difference in percent weight loss between those who had prior hydration education and those who had not was between women's soccer players who had received hydration education (2%), and women's soccer players who had not received hydration education (0.6%). There was also only one significant difference in percent weight loss noted between different training intensities. The difference was between football players who rated their training intensity as very high (0.7%) and women's soccer player who rated their training intensity as very high (2%).

Survey and Weight Chart Correlation

The survey data and the percent weight loss data were combined and used to determine correlations. The athlete who did not complete a page of the attitude section of the survey was removed from this analysis. There were 3 correlation procedures performed using SAS, one for males, one for females, and one for all of the athletes. Among the females, there were significant correlations between total score and knowledge score, total score and behavior score, and total score and attitude score. There was also a correlation between knowledge and attitude scores for females. No correlation was noted for any of the scores and the weight chart data. (Appendix C)

For the males the same correlations were noted between total and the other sections of the survey. In addition, there was also a positive correlation between the attitude and behavior scores. When males and females were pooled together there was a significant correlation between total score and the three section scores of the survey. There was also a significant positive correlation between attitude and both behavior and knowledge scores (Appendix C).

CHAPTER FIVE DISCUSSION

Normally, a Cronbach's alpha score above 0.70 is viewed as strong so the attitude score measures the athletes' attitudes about hydration accurately. The score of 0.64 for behavior also indicates that it accurately measures behavior. The raw knowledge score of 0.19 and lack of standardized knowledge score indicates that the survey did not accurately measure athletes' knowledge of hydration. Some possible reasons for this low score are that several of the questions received the same answer from all of the athletes surveyed. Questions 2, 5, 6, 7, and 8 were answered correctly by all athletes. This means one of three things--either the athletes were knowledgeable about hydration, the questions asked were common knowledge, or there were different kinds of knowledge assessed in the knowledge section of the survey. For example, questions 5, 6, 7, and 8 were all answered correctly and were related to whether or not athletes should drink fluids during training and competition. On other concepts of hydration such as adequate fluid intake levels, athletes were less knowledgeable. In other words, the knowledge section measured more than one latent construct. However, these low Cronbach's alpha scores were not expected because the previous study performed by Nichols et al. (2005) produced high Cronbach's alpha scores for all three sections of the survey. The Cronbach's alpha levels for knowledge, attitude, and behavior in the Nichols et al. (2005) study were 0.94, 0.92, and 0.96 respectively. In the present study, questions were added to each section of the original survey and the questions added may have measured a different area of hydration knowledge than the original questions. For example, questions 14 (Adequate intake for water has been set at 3.7 liters and 2.7

liters for men and women respectively. True or False), 35 (I believe I should drink 3.7 liters of water a day or 2.7 liters of water a day, for men and women respectively, to fulfill my adequate intake. Likert Scale), and 55 (I drink at least 3.7 liters of water a day or 2.7 liters of water a day, for men and women respectively. Yes or No) were added to the knowledge, attitude, and behavior sections, respectively. In the case of question 55, it was the most frequently missed question in the behavior section. To the contrary, question 2 (Nausea, headache, vomiting, and muscle cramps are all signs of dehydration. True or False) was answered correctly by every athlete who completed the survey, and thus may have affected the Cronbach's alpha score for the knowledge section. In addition the lower attitude score may be due to the fact that the questions in the attitude section of this study were scored with their respective answer on the Likert scale, whereas Nichols et al. (2005) scored an attitude question correct as long as it was scored in the positive direction.

Of the 74 athletes who participated in the study, 46 reported that they had received some sort of nutrition or hydration education prior to participating in the study. In addition, 19 of the athletes said they used some sort of supplement to help them stay hydrated. The 74 athletes also had a mean training duration score of 2.28 ± 0.71 , which equates to an average training duration of 3-5 hours per day and a mean training intensity score of 4.35 ± 0.67 , which equates to a training intensity of high to very high. This information suggests that athletes participating in this study train and compete at a high intensity for an extended period of time, and that the majority seem to have some sort of prior knowledge of hydration. Only 62.1% of the athletes in this study had any prior hydration education, yet the scores were higher than those of athletes from a previous study in which 87.1% of the athletes

stated that they had received prior hydration education (Nichols et al., 2005). It is possible that the hydration education received by the athletes in this study was more athletics specific, thus they may have received more information about proper hydration.

As expected the athletes performed very well on the survey, with a mean score of 115.54 ± 10.79 or 83.72%. This indicates that the athletes have a good knowledge about proper hydration, a strong belief in that information, and that they use it as a guide to stay hydrated. The mean correct score of 83.72% is higher than the 70.78% reported by Nichols et al. (2005). The survey used in this study was based on that used by Nichols et al. (2005).

Overall, the athletes did well on the knowledge section of the survey with a mean knowledge score of 17.54 ± 1.91 or 87.7%. The only two significant differences noted were between class year and training intensity. The 2nd year students scored significantly higher on the knowledge section than did the 4th year students, and the athletes who listed their training intensity as high scored significantly higher than those who listed their training intensity as very high. The high knowledge scores may reflect age and years of collegiate experience. The mean age for athletes participating in this study was 19.74 ± 1.39 and the mean year in school was 2.58 ± 1.19 , meaning that, on average, they have been participating in athletics at the collegiate level over 2 years. Athletes in the study performed by Nichols et al. (2005) answered 81.7% of their knowledge section questions correctly, even though they were similar in mean age 19.8 ± 1.5 . However, the majority of the athletes in the study performed by Nichols et al. (2005) were underclassmen (56.8%), compared to the mean class year of the athletes in the present study of 2.58 ± 1.19

indicating upperclassmen status. It has been well documented and reported that dehydration can lead to a decrease in performance (von Duvillard, 2004), so it is not surprising that athletes training and competing at a high level would have good knowledge about hydration information.

Overall the athletes did well on the attitude section of the survey. The mean score was 84.01 ± 9.12 out of a possible 100. There were no significant differences noted for attitude scores between any of the demographic variables. Furthermore, attitude scores were significantly correlated with both behavior and knowledge scores. It is hard to compare the results from the attitude section of this study to the results of Nichols et al. (2005) since they scored the attitude section of the survey by direction of attitude only and not by strength of attitude. Nevertheless, the mean attitude score was 58.8% in the Nichols et al. (2005) study, meaning that the attitude questions were answered in the right direction 58.8% of the time. In this study, the mean score was 84.01 out of a possible 100.

The behavior section of the survey asks whether or not athletes follow certain hydration methods. The behavior score should be a direct reflection of how well athletes re-hydrate themselves. The mean behavior score for the study was 13.98 ± 2.71 or 77.66%. Although the score of 77.66% is high, it is not as high as either the knowledge or attitude mean scores. The men's and women's soccer teams both scored significantly higher on the behavior section than did the men's and women's cross country team. This may be explained by the fact that both the men's and women's soccer teams had significantly higher training duration and training intensity scores than both the men's and women's cross country teams. This is further supported by the fact that those who had higher training intensities and

durations scored significantly higher on the behavior section than others. Also those who said they used supplements to aid in hydration scored significantly higher than those who did not. Nichols et al. (2005) also found a significant difference in behavior score between endurance and skill sports, however soccer and cross country were both considered endurance sports, whereas in this study they were separated by individual team. Overall, the athletes in the previous study scored about the same as the athletes in this study scoring 72.9% correct compared to 77.66% correct (Nichols et al., 2005). The behavior scores are the most significant scores because, if answered honestly, they are a direct reflection of how well athletes re-hydrate themselves.

The weight chart data provides information on how well the athletes hydrated themselves in between training sessions. The only significant differences in percent weight loss replaced were noted between the men's soccer players and women's soccer players who trained for the same amount of time. The men's soccer players had a mean of 104.66% meaning they completely replaced their fluid loss and then some, while the women had a mean of only 41.93%. Godek et al. (2005) studied hydration status in collegiate football players during preseason and found that the players consistently lost weight due to fluid loss over an 8 day period. Although this study just used a flat weight measurement rather than a percentage, it appears that athletes participating in preseason training may lose significant amounts of weight due to fluid loss, and thus affect their hydration status. There was no significant negative correlation between total score and percent weight loss replaced for all of the athletes nor was there a significant positive correlation between high scores on the survey and high percent replacement.

There are several possible explanations for the results of this study. First, perhaps the athletes used for the study were knowledgeable about hydration and practiced good habits in regards to hydration. There are also several sources of possible errors in the weight log data given that the athletes were responsible for weighing themselves and recording their weights. Another source of possible error is that the study was not designed to control or measure fluid intake or fluid loss during training sessions, which may have impacted body weight. The athletes at this University appear to be very knowledgeable about hydration, but it can not be proven that their knowledge results in adequate re-hydration in between training sessions. For this reason it is important to continue to educate collegiate athletes about hydration and to ensure that they have access to proper fluids to maintain hydration.

APPENDICES

Appendix A

Materials

Permission Letter.

Hello

I was Phillip's faculty advisor and I helped him develop the survey instrument. You have my permission to use it for your research. I am attaching an electronic copy of the survey used in the research. Please keep me posted on how you might use it and if you publish, please acknowledge the article and use of the instrument.

Best
wishes.

PS. I have a house on Lake Hartwell

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Informed Consent Form

Consent Form for Participation in a Research Study Clemson University

Assessment of Knowledge and Practices Affecting Hydration Status of Clemson University Student-Athletes

Description of the research and your participation

You are invited to participate in a research study conducted by Dr. Beth Kunkel and Jeffie Trammell. The purpose of this research is determine what you know about hydration during training and competition and how well you put that knowledge into practice. Members of the men's football, men's soccer, women's soccer, women's volleyball, men's cross-country and women's cross-country teams are being invited to participate in this study.

Your participation will involve completing a survey about hydration. We will also be accessing your weights from your team's weight log.

The amount of time required for your participation will be about 20 minutes to complete the survey.

Risks and discomforts

There are no known risks associated with this research.

Potential benefits

There are no known benefits to you that would result from your participation in this research. This research may help us to understand what student-athletes know about hydration and how well they put their knowledge into practice and then to design educational programs that help student-athletes understand the importance of adequate hydration.

Protection of confidentiality

We will do everything we can to protect your privacy. You will be asked not to identify yourself on the survey. The weight log will be kept the way it usually is for your team. After pre-season training, we will remove your name from the weight log and assign a code number to your weights on the weight logs and will use that information in analyzing your data. Your identity will not be revealed in any publication that might result from this study.

In rare cases, a research study will be evaluated by an oversight agency, such as the Clemson University Institutional Review Board or the federal Office for Human Research Protections. This would require that we share the information we collect from

This form is valid only if the
Clemson University IRB
stamp of approval is shown here:

Revised: June 2005
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you. If this happens, the information would only be used to determine if we conducted this study properly and adequately protected your rights as a participant.

Voluntary participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Beth Kunkel at Clemson University at 864-656-5690. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Institutional Review Board at 864.656.6460.

Consent

I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.

Participant's signature: _____ Date: _____

A copy of this consent form should be given to you.

This form is valid only if the
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stamp of approval is shown here:

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Original Survey

Fluid and Hydration Survey

Please answer the following questions about fluids and hydration. Do NOT put your name on the survey. Your answers will be kept confidential so please be honest in your answers.

Part 1:

1. Gender: _____ Male _____ Female

2. Age: _____

3. Please indicate which ethnic group you most identify. (check one)

- White (non-Latino)
- Latino
- Asian & Pacific Islander
- African American
- Native American
- Mixed Race
- Other: _____

4. Indicate your year in school. (check one)

- Freshman
- Sophomore
- Junior
- Senior
- Fifth year senior

5. On which athletic team do you participate at Georgia State University?
(circle all that apply)

- | | | | |
|-------------------------------------|-----------------------------------|--------------------------------|-----------------------------------|
| <input type="checkbox"/> Basketball | <input type="checkbox"/> Softball | <input type="checkbox"/> Track | <input type="checkbox"/> Football |
| <input type="checkbox"/> Tennis | <input type="checkbox"/> Baseball | <input type="checkbox"/> Golf | <input type="checkbox"/> Swimming |

- | | | |
|---------------------------------|--|-------------------------------------|
| <input type="checkbox"/> Soccer | <input type="checkbox"/> Cross Country | <input type="checkbox"/> Volleyball |
|---------------------------------|--|-------------------------------------|

6. Please check all that apply to you.

- I have taken a nutrition class in college.
- I have sat in on a nutrition lecture given by a dietitian in college.
- I have had nutrition education at a freshman orientation.
- I have never received nutrition education.
- Other: (please describe) _____

Part 2: The following questions will assess your knowledge, attitudes and behaviors on fluids and hydration. Read each statement carefully and select the best response.

Please circle true (T) or false (F) for each question.

- | | | |
|---|---|---|
| 1. Using salt tablets keeps athletes from getting dehydrated during training and competition. | T | F |
| 2. Thirst is the best indicator of dehydration. | T | F |
| 3. Dehydration decreases athletic performance. | T | F |
| 4. An athlete should not drink water or any fluids during practice. | T | F |
| 5. Coaches should not let players drink any fluids during practice. | T | F |
| 6. Coaches should not let players drink any fluids during competition. | T | F |
| 7. It is important for fluids to be readily available to athletes during practice. | T | F |
| 8. It is important for fluids to be readily available to athletes during competition. | T | F |

9. Within 2 hours after exercise, athletes should drink a sports drink.	T	F
10. Sports drinks are better than water because they restore glycogen in muscles.	T	F
11. An athlete should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	T	F
12. An athlete should drink 7 to 10 fluid ounces 10-20 minutes before competition.	T	F
13. When exercising for more than an hour, an athlete should drink a sports drink rather than water.	T	F
14. By monitoring the color of urine, an athlete can judge if he/she is dehydrated.	T	F
15. A good way for an athlete to determine how much water or sports drink to consume after practice is to weigh before and after practice.	T	F
16. Excessive sweating, thirst, and cramping are signs of dehydration.	T	F
17. More than 2 drinks of alcohol the day before practice and/or competition can lead to dehydration.	T	F
	<small>Circle strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD) for each statement.</small>	
18. I believe using salt tablets will keep me from getting dehydrated during training and competition.	SA	A U D SD
19. I believe I can rely on thirst alone as an indicator of dehydration.	SA	A U D SD
20. I believe dehydration decreases my athletic performance.	SA	A U D SD
21. I believe no water or fluids should be consumed during practice.	SA	A U D SD
22. I believe my coach should not let our players drink any fluids during practice.	SA	A U D SD
23. I believe my coach should not let our players drink any fluids during competition.	SA	A U D SD
24. I believe fluids should be readily available to me during practice.	SA	A U D SD
25. I believe fluids should be readily available to me during competition.	SA	A U D SD
26. I believe within 2 hours after exercise, I should drink a sports drink.	SA	A U D SD
27. I think sports drinks are better than water because they restore glycogen in muscles.	SA	A U D SD
28. I think I should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	SA	A U D SD
29. I believe I should drink 7 to 10 fluid ounces of water or sports drink 10-20 minutes before competition.	SA	A U D SD
30. I believe when exercising for more than an hour, I should drink a sports drink rather than water.	SA	A U D SD
31. I believe by monitoring the color of my urine, I can judge if I am dehydrated.	SA	A U D SD
32. I believe that weighing myself before and after practice is a good way to determine how much fluid I lost.	SA	A U D SD

	SA	A	U	D	SD
33. I believe that excessive sweating, thirst, and cramping are signs of dehydration.					
34. I believe that drinking more than 2 drinks of alcohol the day before competing can lead to dehydration.	SA	A	U	D	SD
	<i>Please circle yes (Y) or no (N) for each statement.</i>				
35. I use salt tablets to keep from being dehydrated when training and competing.			Y		N
36. I use thirst alone as a way to tell if I am dehydrated.				Y	N
37. I drink plenty of fluids so my athletic performance will not decrease due to dehydration.				Y	N
38. I do not drink water or some type of fluid during practice.				Y	N
39. My coach does not allow me to drink fluids during practice.				Y	N
40. My coach does not allow me to drink fluids during competition.				Y	N
41. Fluids are readily available to me during practice.				Y	N
42. Fluids are readily available to me during competition.				Y	N
43. Within 2 hours after exercise, I drink a sports drink.				Y	N
44. I drink sports drinks rather than water to restore glycogen in my muscles.				Y	N
45. I drink approximately 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.				Y	N
46. I drink at least 7 to 10 fluid ounces of water or sports drink 10-20 minutes before the game.				Y	N
47. I drink sports drinks rather than water when competing for more than an hour.				Y	N
48. I use the color of my urine to determine if I am dehydrated.				Y	N
49. I weigh myself before and after practice to see how much weight I have lost from sweating and use this to determine how much water or sports drink to consume.				Y	N
50. I use excessive sweating, thirst, and cramping to warn me if I am getting dehydrated.				Y	N
51. I drink more than 2 drinks of alcohol the day before competition.				Y	N

Revised Survey

Fluid and Hydration Survey

Please answer the following questions about fluids and hydration. Do NOT put your name on the survey. Your answers will be kept confidential so please be honest in your answers.

Part 1:

1. Gender: _____ Male _____ Female

2. Age: _____

3. Please indicate which ethnic group you most identify. (check one)

____ White (non-Latino)

____ Latino

____ Asian & Pacific Islander

____ African American

____ Native American

____ Mixed Race

Other: _____

4. Indicate your year in school. (check one)

____ Freshman

____ Sophomore

____ Junior

____ Senior

____ Fifth year senior

5. On which athletic team do you participate at Clemson University?
(circle all that apply)

Football

Volleyball

Soccer

Cross Country

6. On average, approximately how many hours a day do you train during the preseason?
(circle one)

<3 hours

3-5 hours

5-7 hours

7-9 hours

>9 hours

7. How would you rate the intensity of your preseason training?
(circle one)

Very Low

Low

Moderate

High

Very High

8. Do you consume any added supplements to help aid you in hydration during preseason training?
(circle one)

Yes

No

If "Yes" please give name of supplement and brief description of what it does.
(I.E. Heat Guard for Electrolyte Replacement)

9. Please check all that apply to you.

____ I have taken a nutrition class in college.

____ I have sat in on a nutrition lecture given by a dietitian in college.

____ I have had nutrition education at a freshman orientation.

____ I have never received nutrition education.

____ Other: (please describe) _____

Part 2: The following questions will assess your knowledge, attitudes and behaviors on fluids and hydration. Read each statement carefully and select the best response.

Please circle true (T) or false (F) for each question.

1. Using salt tablets keeps athletes from getting dehydrated during training and competition.

T

F

- | | | |
|--|---|---|
| 2. Nausea, headache, vomiting, and muscle cramps are all signs of dehydration. | T | F |
| 3. Thirst is the best indicator of dehydration. | T | F |
| 4. Dehydration decreases athletic performance. | T | F |
| 5. An athlete should not drink water or any fluids during practice. | T | F |
| 6. Coaches should not let players drink any fluids during practice. | T | F |
| 7. Coaches should not let players drink any fluids during competition. | T | F |
| 8. It is important for fluids to be readily available to athletes during practice. | T | F |
| 9. It is important for fluids to be readily available to athletes during competition. | T | F |
| 10. Within 2 hours after exercise, athletes should drink a sports drink. | T | F |
| 11. Sports drinks are better than water because they restore glycogen in muscles. | T | F |
| 12. An athlete should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition. | T | F |
| 13. An athlete should drink 7 to 10 fluid ounces 10-20 minutes before competition. | T | F |
| 14. Adequate intake for water has been set at 3.7 liters and 2.7 liters for men and women respectively. | T | F |
| 15. When exercising for more than an hour, an athlete should drink a sports drink rather than water. | T | F |
| 16. By monitoring the color of urine, an athlete can judge if he/she is dehydrated. | T | F |
| 17. A good way for an athlete to determine how much water or sports drink to consume after practice is to weigh before and after practice. | T | F |
| 18. Excessive sweating can lead to dehydration. | T | F |
| 19. Receiving IV fluids is an effective way to replace fluids in cases of serious dehydration. | T | F |
| 20. Drinking caffeinated beverages in between training sessions and competition can lead to dehydration. | T | F |
| 21. More than 2 drinks of alcohol the day before practice and/or competition can lead to dehydration. | T | F |

Circle strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD) for each statement.

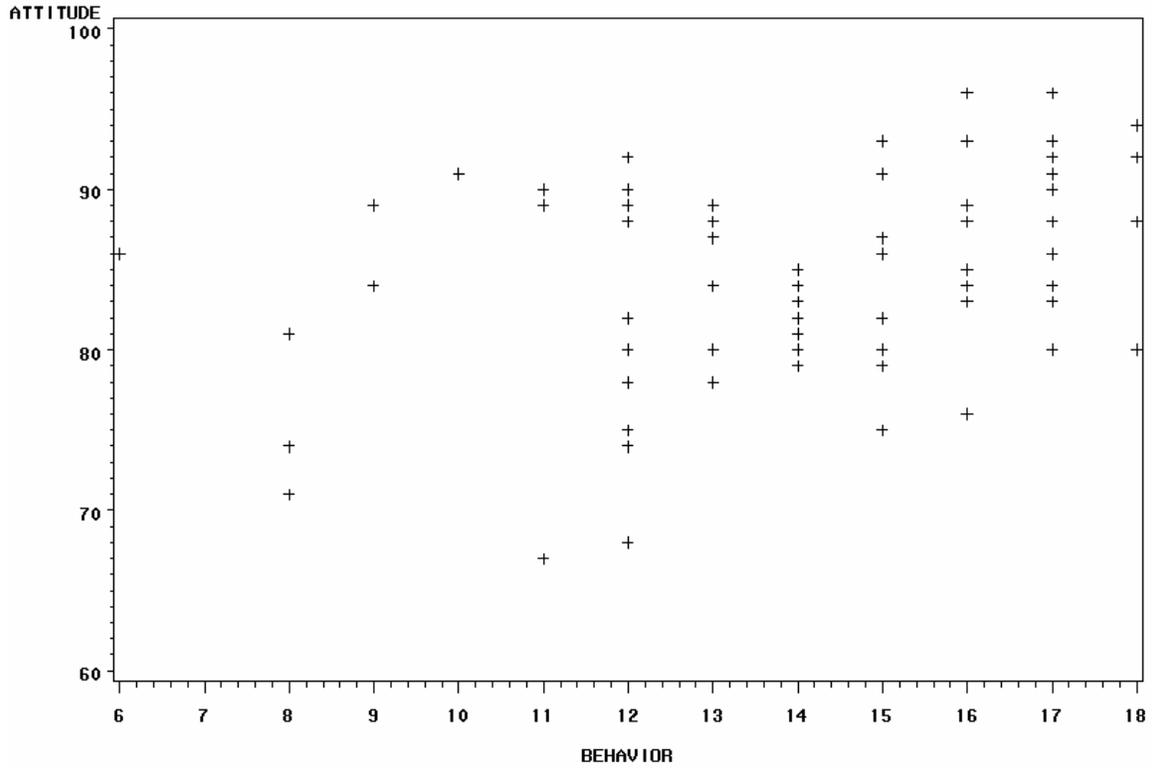
- | | | | | | |
|--|----|---|---|---|----|
| 22. I believe using salt tablets will keep me from getting dehydrated during training and competition. | SA | A | U | D | SD |
| 23. I believe if I experience nausea, headache, vomiting, or muscle cramps I may be dehydrated. | SA | A | U | D | SD |
| 24. I believe I can rely on thirst alone as an indicator of dehydration. | SA | A | U | D | SD |
| 25. I believe dehydration decreases my athletic performance. | SA | A | U | D | SD |

26. I believe no water or fluids should be consumed during practice.	SA	A	U	D	SD
27. I believe my coach should not let our players drink any fluids during practice.	SA	A	U	D	SD
28. I believe my coach should not let our players drink any fluids during competition.	SA	A	U	D	SD
29. I believe fluids should be readily available to me during practice.	SA	A	U	D	SD
30. I believe fluids should be readily available to me during competition.	SA	A	U	D	SD
31. I believe within 2 hours after exercise, I should drink a sports drink.	SA	A	U	D	SD
32. I think sports drinks are better than water because they restore glycogen in muscles.	SA	A	U	D	SD
33. I think I should drink 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	SA	A	U	D	SD
34. I believe I should drink 7 to 10 fluid ounces of water or sports drink 10-20 minutes before competition.	SA	A	U	D	SD
35. I believe I should drink 3.7 liters of water a day or 2.7 liters of water a day, for men and women respectively, to fulfill my adequate intake.	SA	A	U	D	SD
36. I believe when exercising for more than an hour, I should drink a sports drink rather than water.	SA	A	U	D	SD
37. I believe by monitoring the color of my urine, I can judge if I am dehydrated.	SA	A	U	D	SD
38. I believe that weighing myself before and after practice is a good way to determine how much fluid I lost.	SA	A	U	D	SD
39. I believe that excessive sweating can lead to dehydration.	SA	A	U	D	SD
40. I believe receiving IV fluids is an effective way to replace fluids in cases of serious dehydration.	SA	A	U	D	SD
41. I believe that drinking caffeinated beverages in between training sessions and competition can lead to dehydration.	SA	A	U	D	SD
42. I believe that drinking more than 2 drinks of alcohol the day before competing can lead to dehydration.	SA	A	U	D	SD
43. I use salt tablets to keep from being dehydrated when training and competing.	<i>Please circle yes (Y) or no (N) for each statement.</i>				
		Y	N		
44. I have experienced nausea, headache, vomiting, and muscle cramps as a result of dehydration.		Y	N		
45. I use thirst alone as a way to tell if I am dehydrated.		Y	N		
46. I drink plenty of fluids so my athletic performance will not decrease due to dehydration.		Y	N		
47. I do not drink water or some type of fluid during practice.		Y	N		
48. Fluids are readily available to me during practice.		Y	N		
49. Fluids are readily available to me during competition.		Y	N		
50. Within 2 hours after exercise, I drink a sports drink.		Y	N		

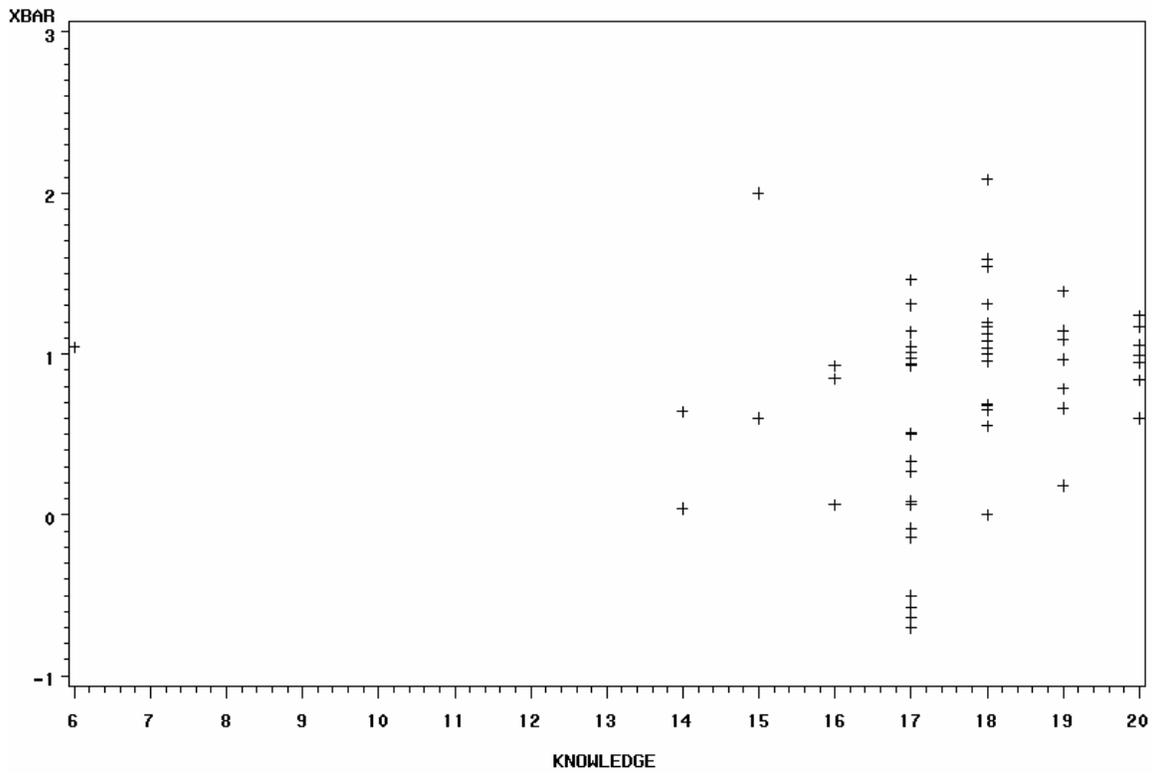
51. I drink sports drinks rather than water to restore glycogen in my muscles.	Y	N
52. I drink approximately 17 to 20 fluid ounces of water or sports drink a couple of hours before competition.	Y	N
53. I drink at least 7 to 10 fluid ounces of water or sports drink 10-20 minutes before the game.	Y	N
54. I drink at least 3.7 liters of water a day or 2.7 liters of water a day, for men and women respectively.	Y	N
55. I drink sports drinks rather than water when competing for more than an hour.	Y	N
56. I use the color of my urine to determine if I am dehydrated.	Y	N
57. I weigh myself before and after practice to see how much weight I have lost from sweating and use this to determine how much water or sports drink to consume.	Y	N
58. I use excessive sweating to warn me if I am getting dehydrated.	Y	N
59. I have received IV fluids as a result of serious dehydration.	Y	N
60. I drink caffeinated beverages in between training sessions and competition.	Y	N

Appendix B

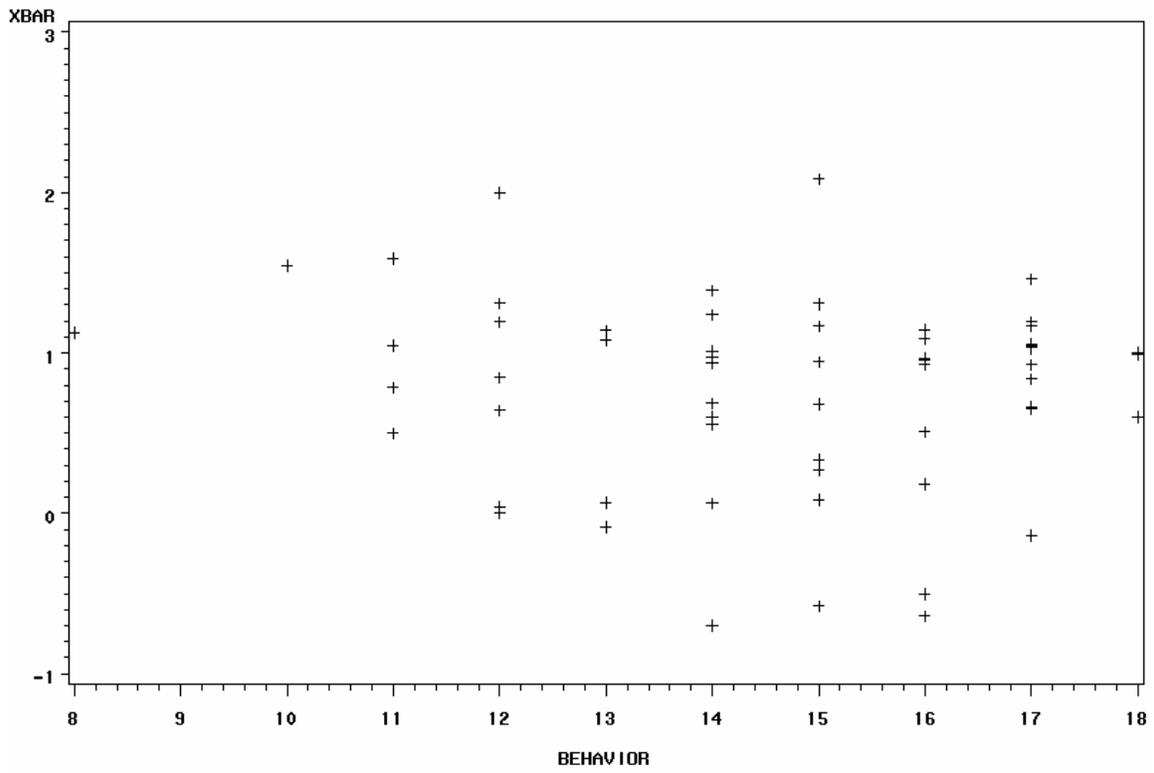
Attitude vs Behavior



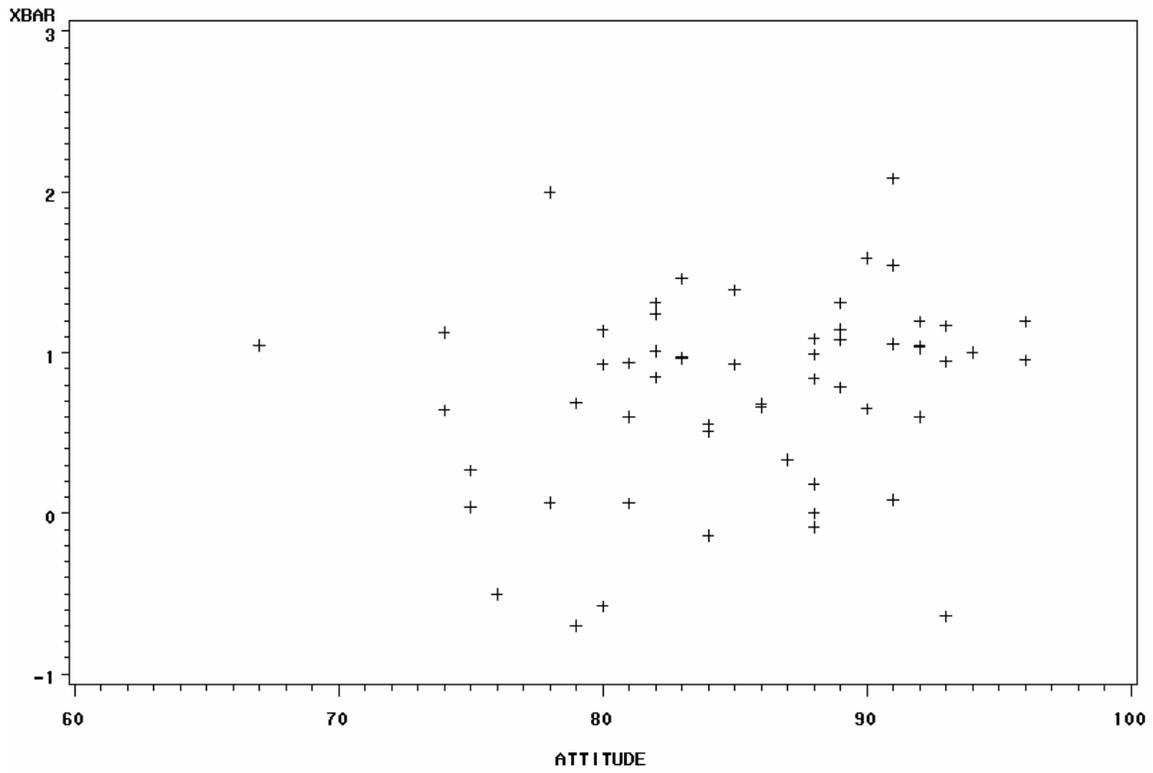
Percent Weight Loss Replaced vs Knowledge



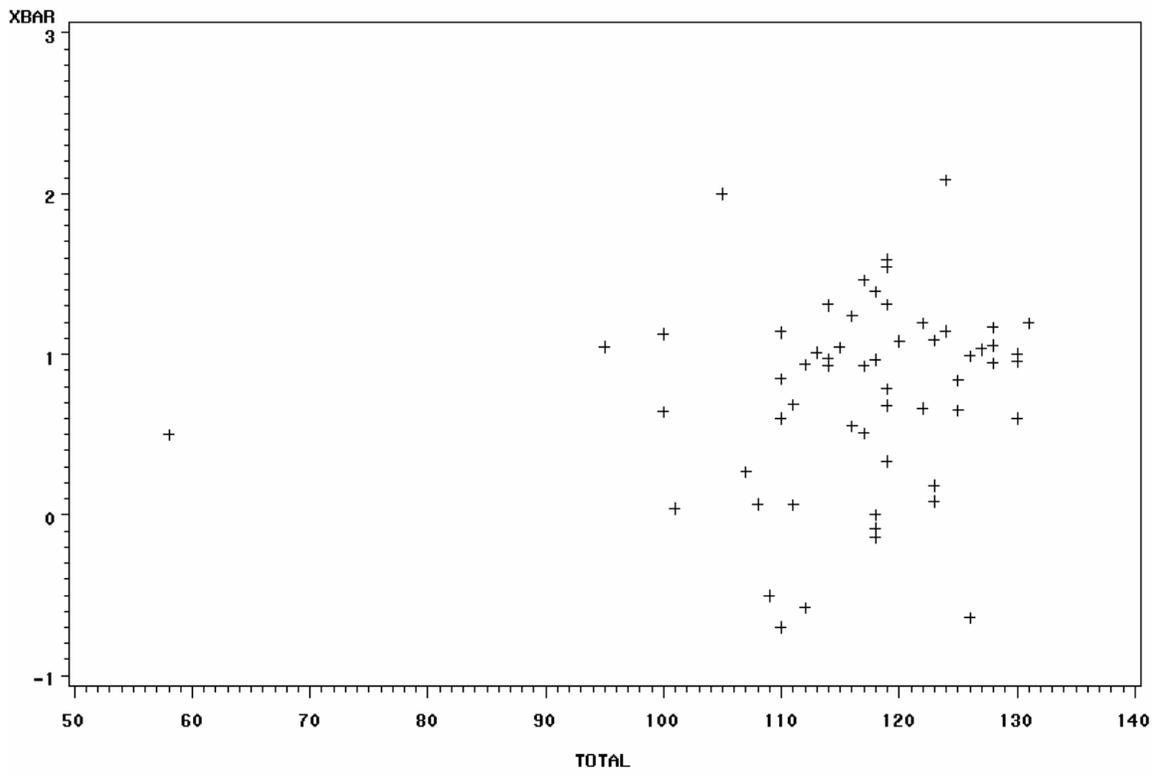
Percent Weight Loss Replaced vs Behavior



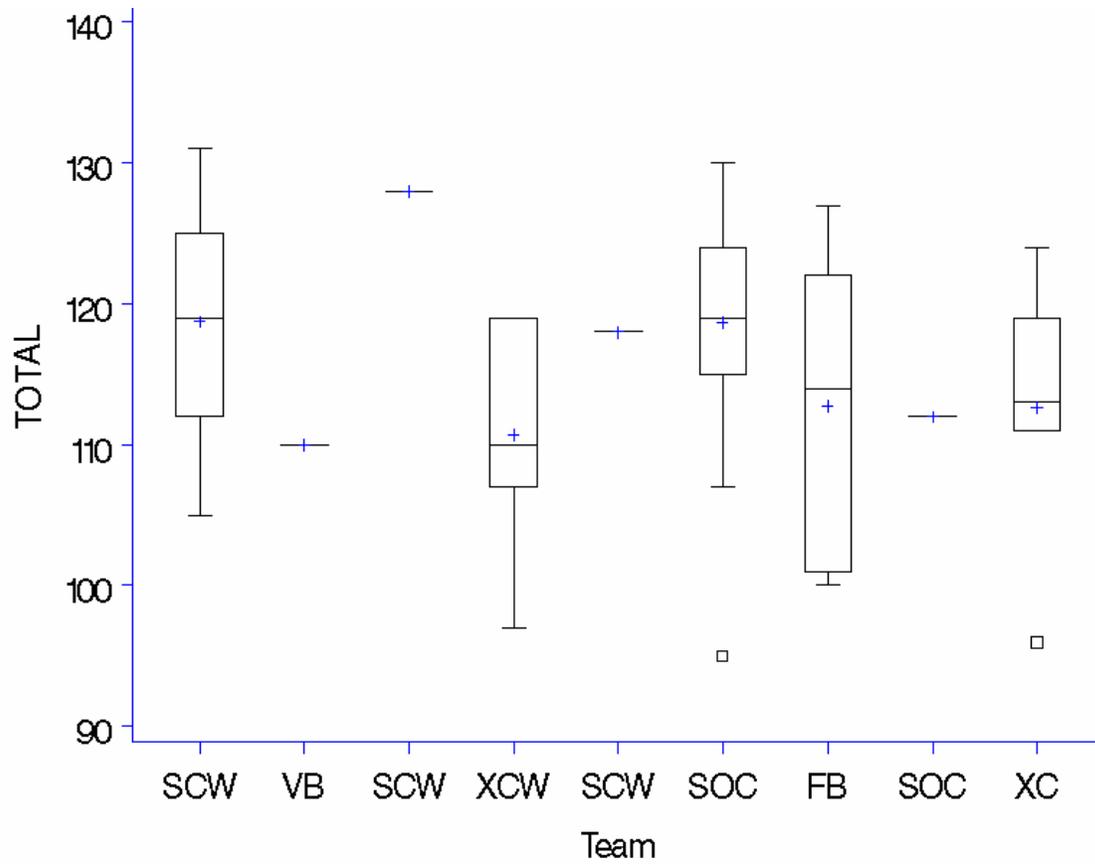
Percent Weight Loss Replaced vs Attitude



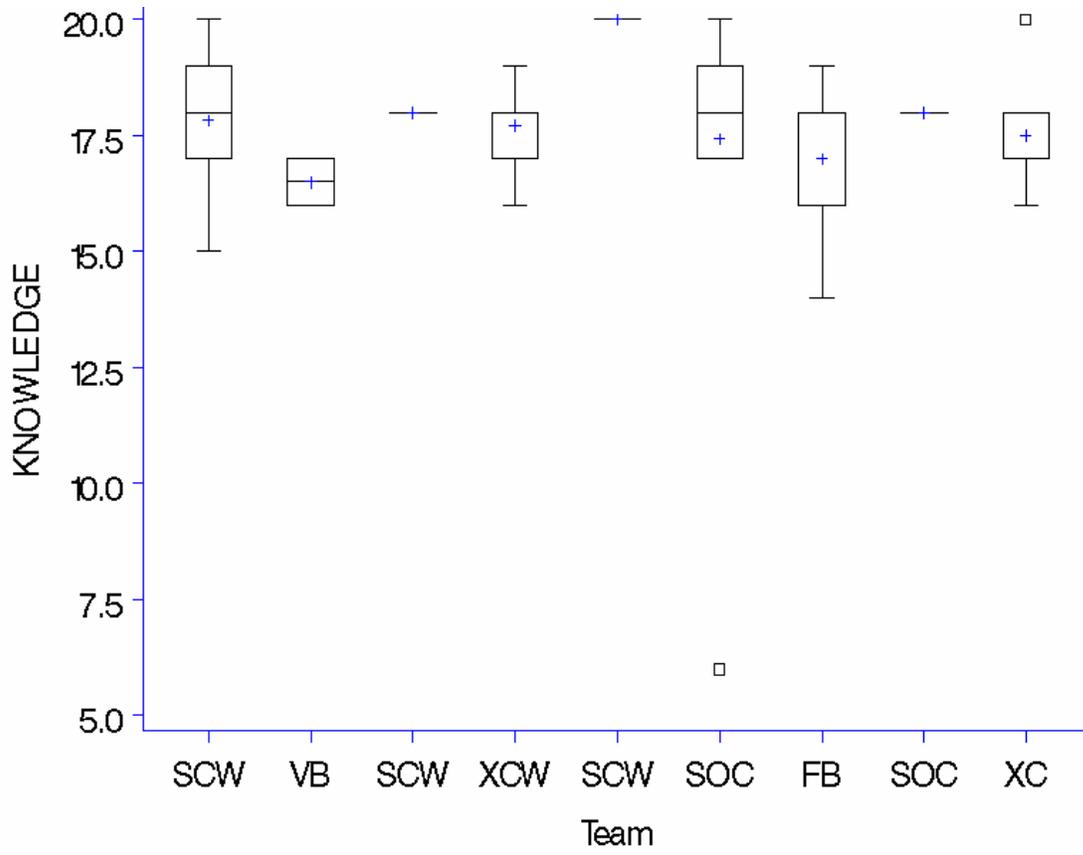
Percent Weight Loss Replaced vs Total



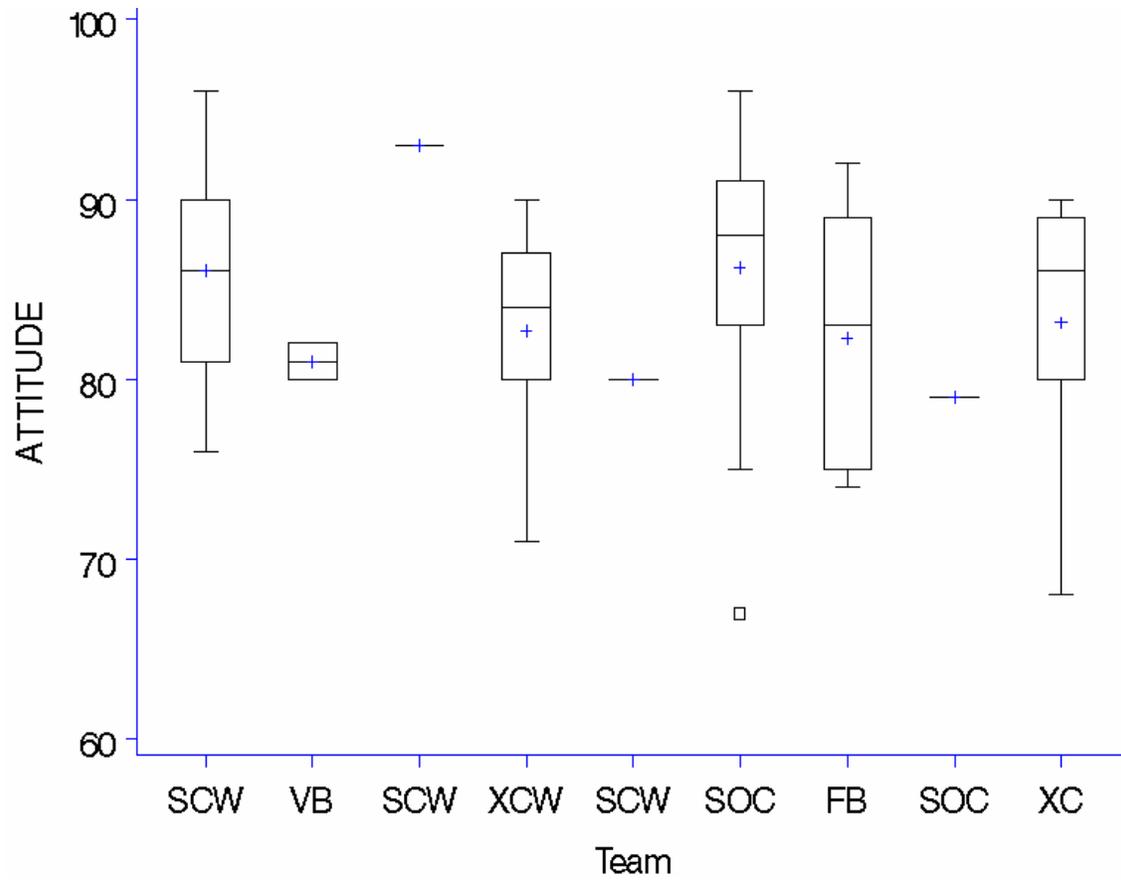
Total Score vs. Team



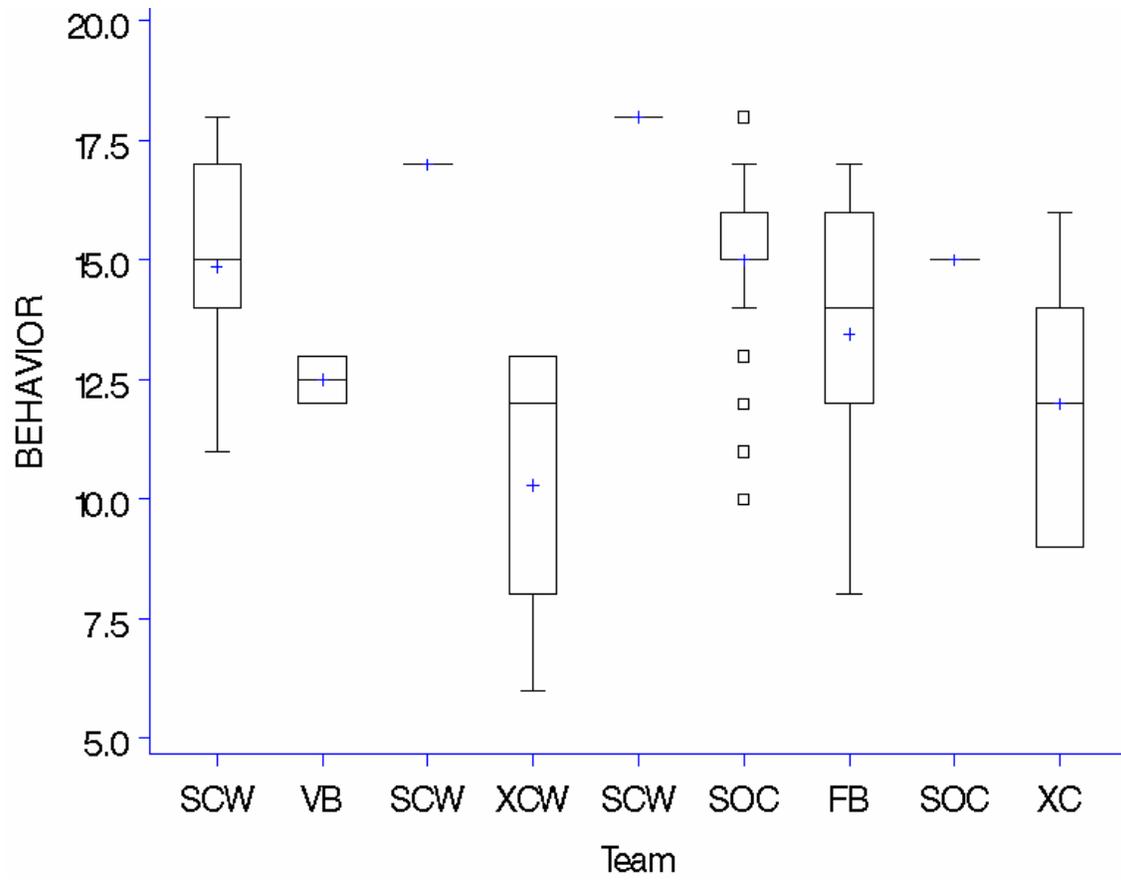
Knowledge Score vs. Team



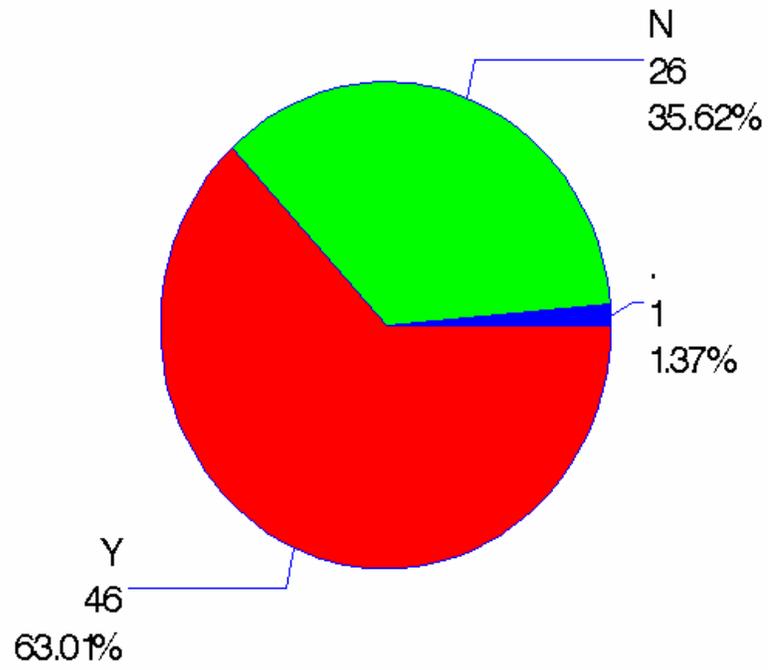
Attitude Score vs. Team



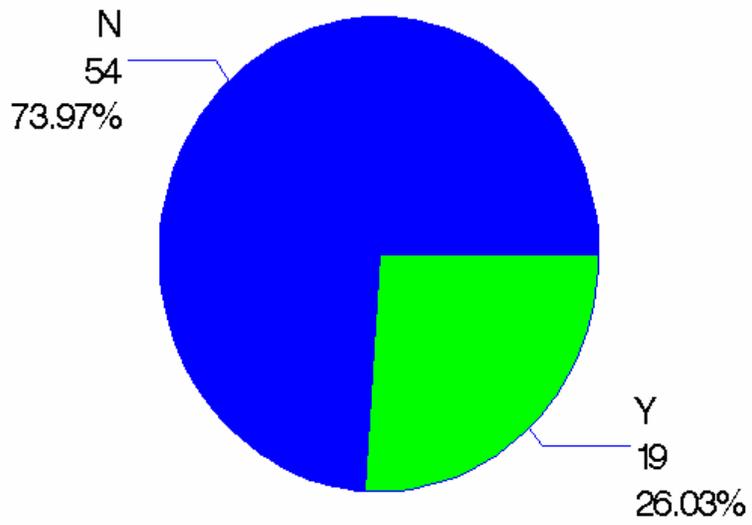
Behavior Score vs. Team



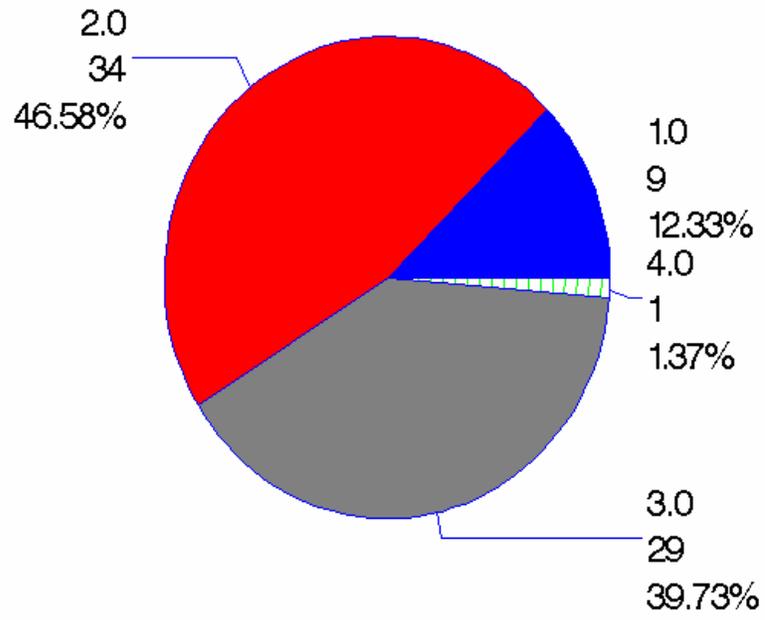
FREQUENCY of Education



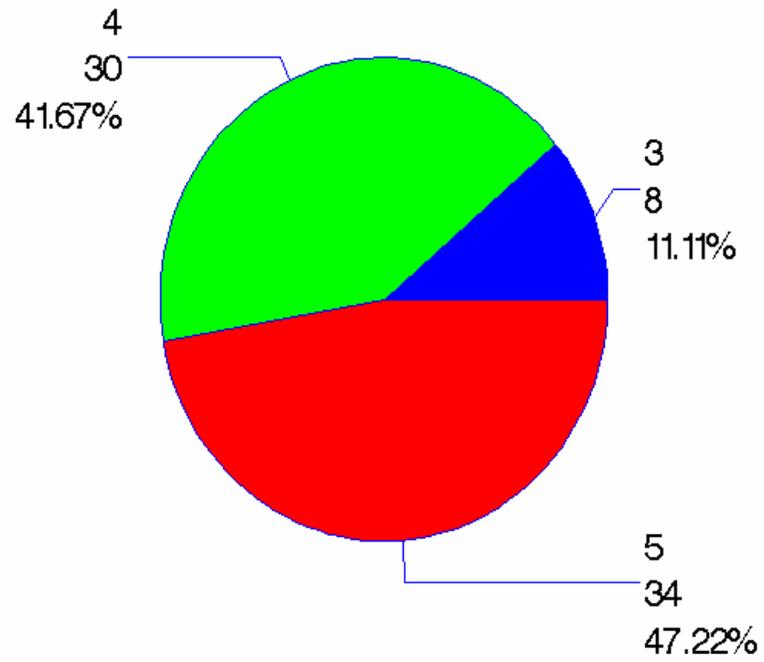
FREQUENCY of Supplements



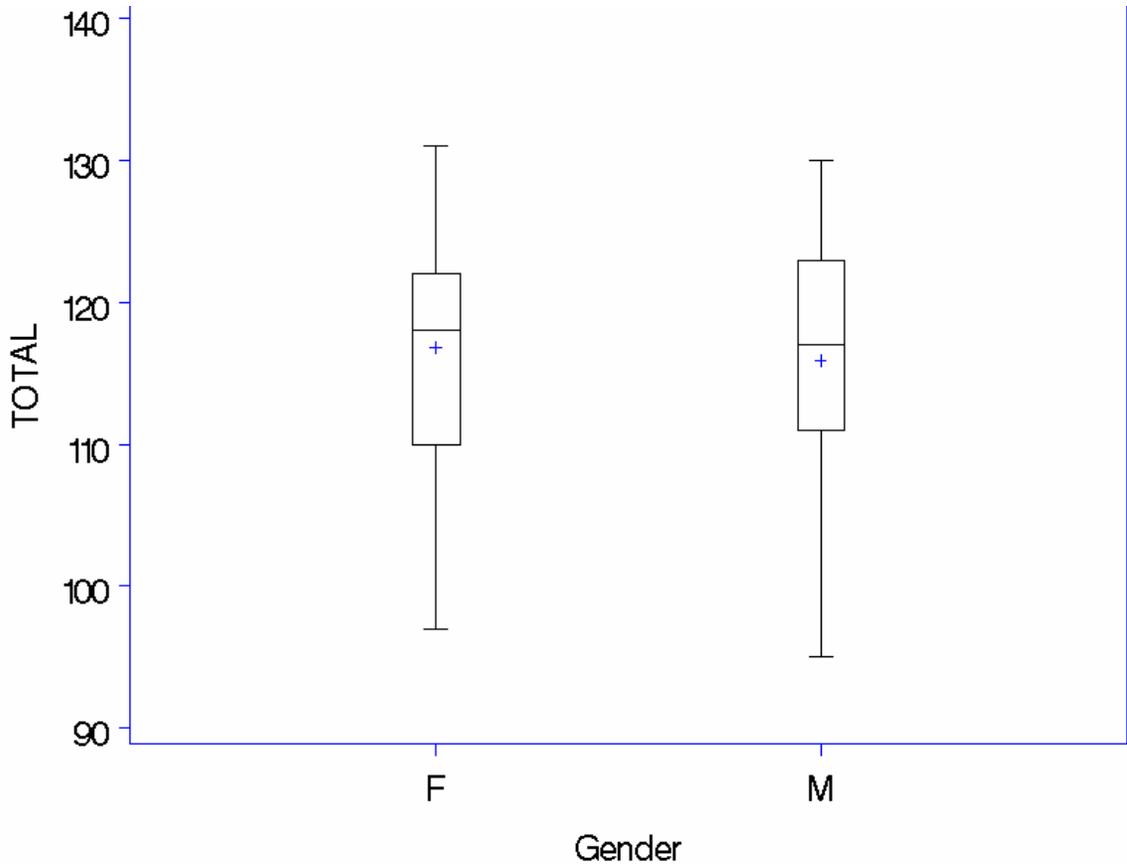
FREQUENCY of TR_Duration



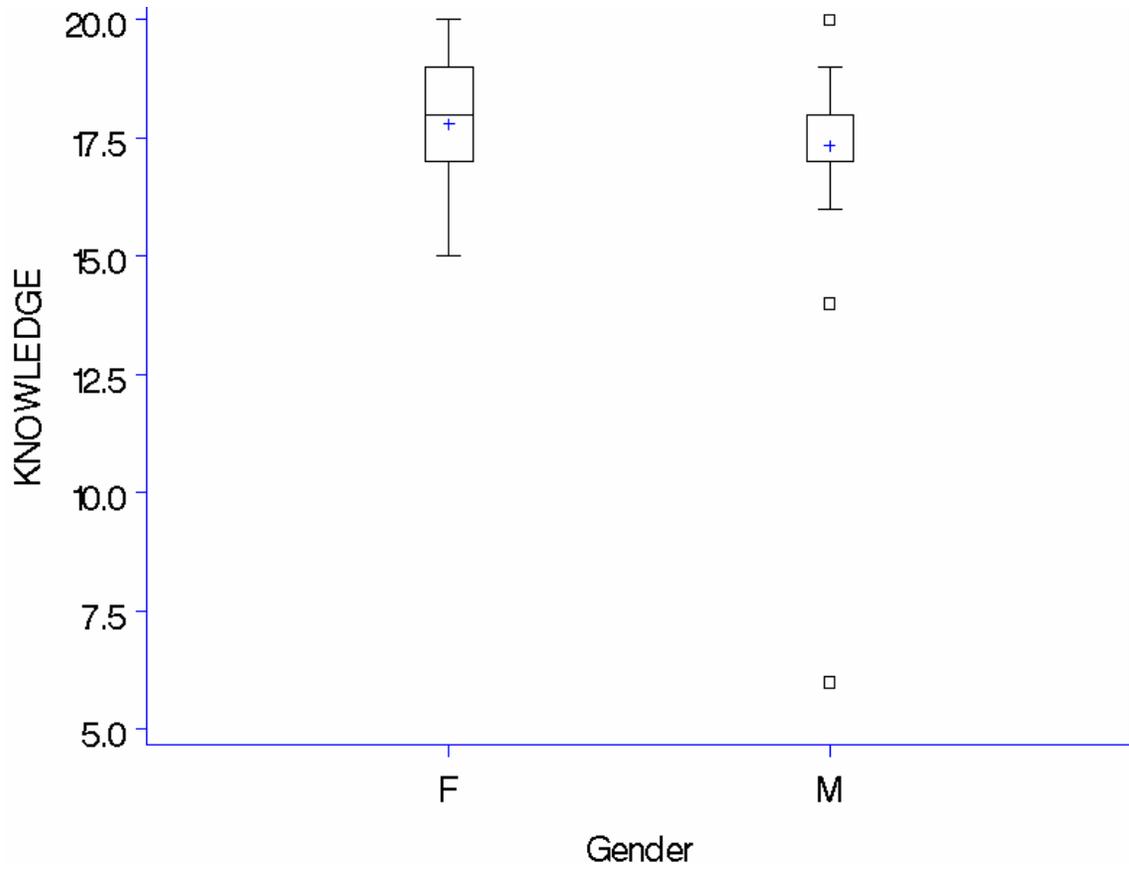
FREQUENCY of TR_Intensity



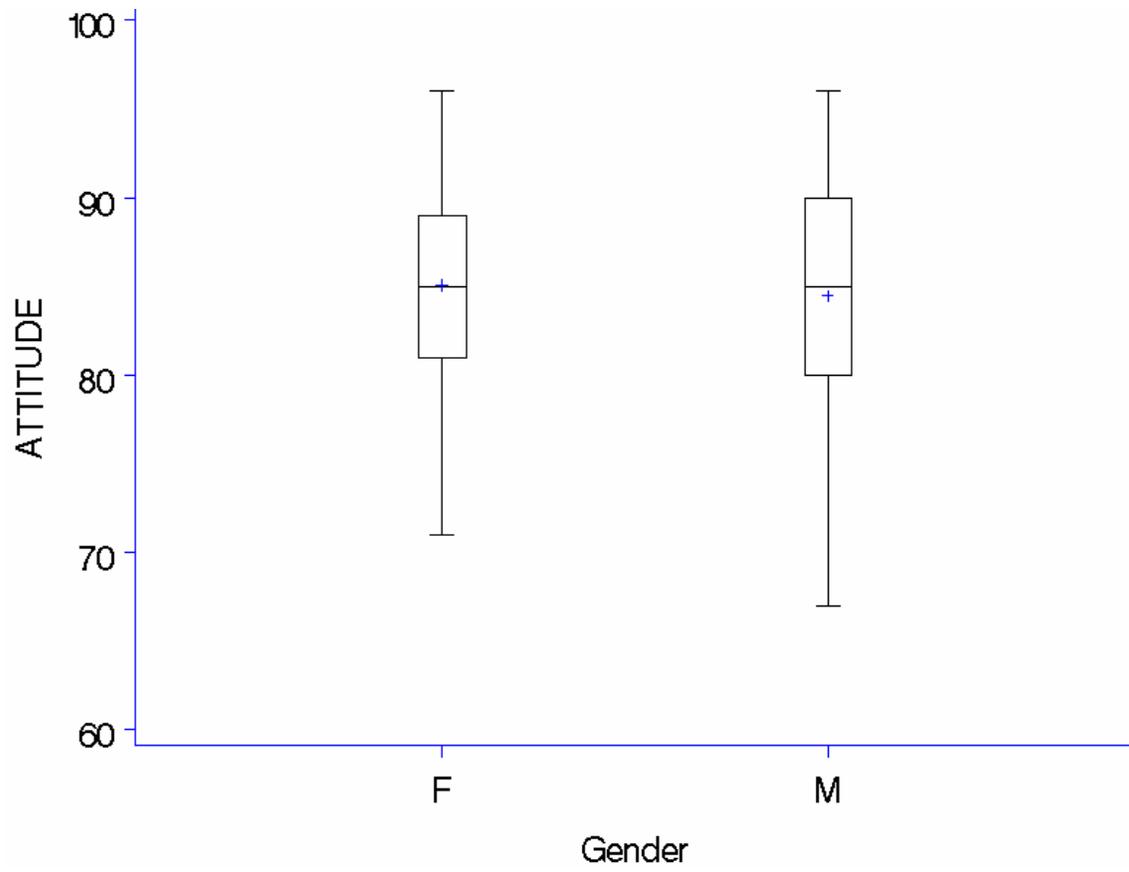
Total Score vs. Gender



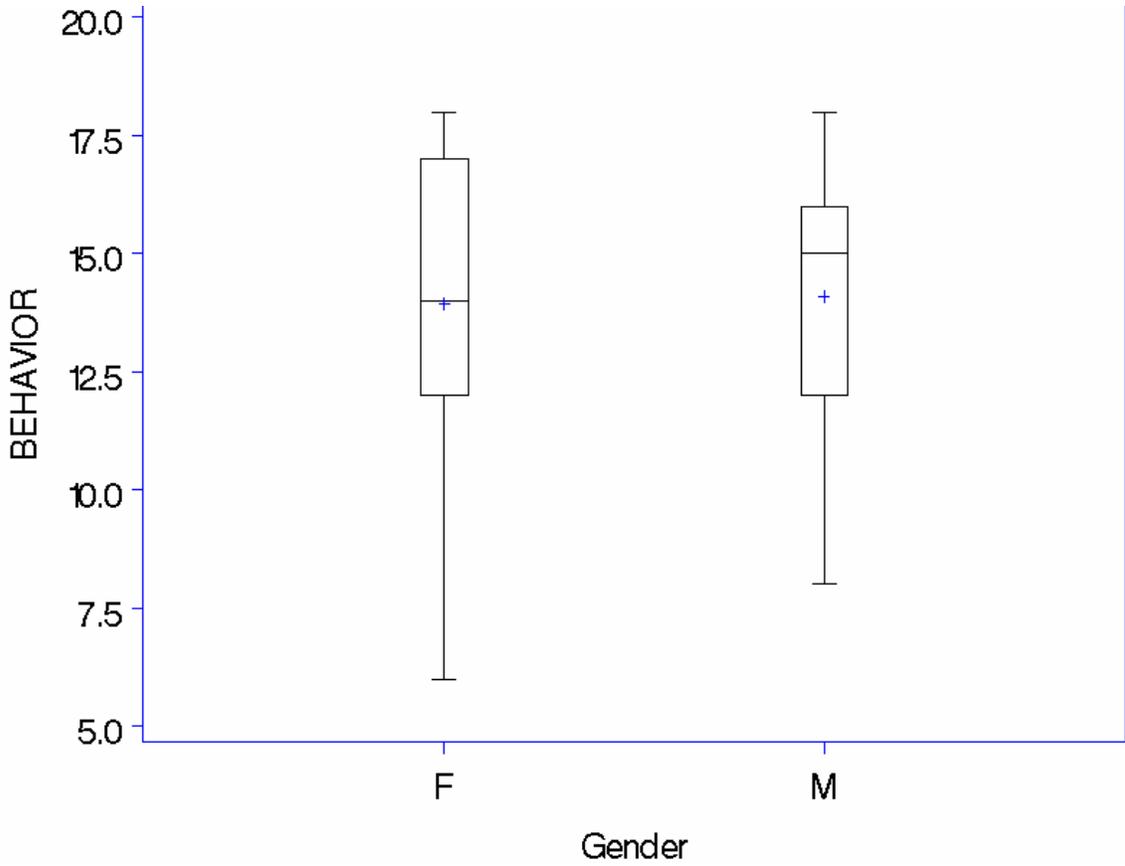
Knowledge Score vs. Gender



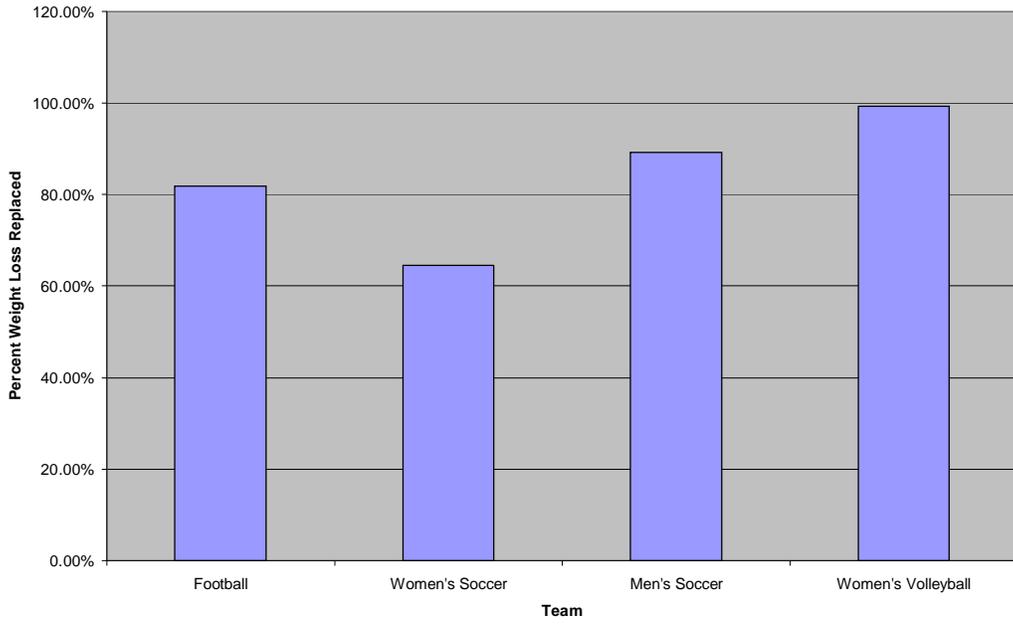
Attitude Score vs. Gender



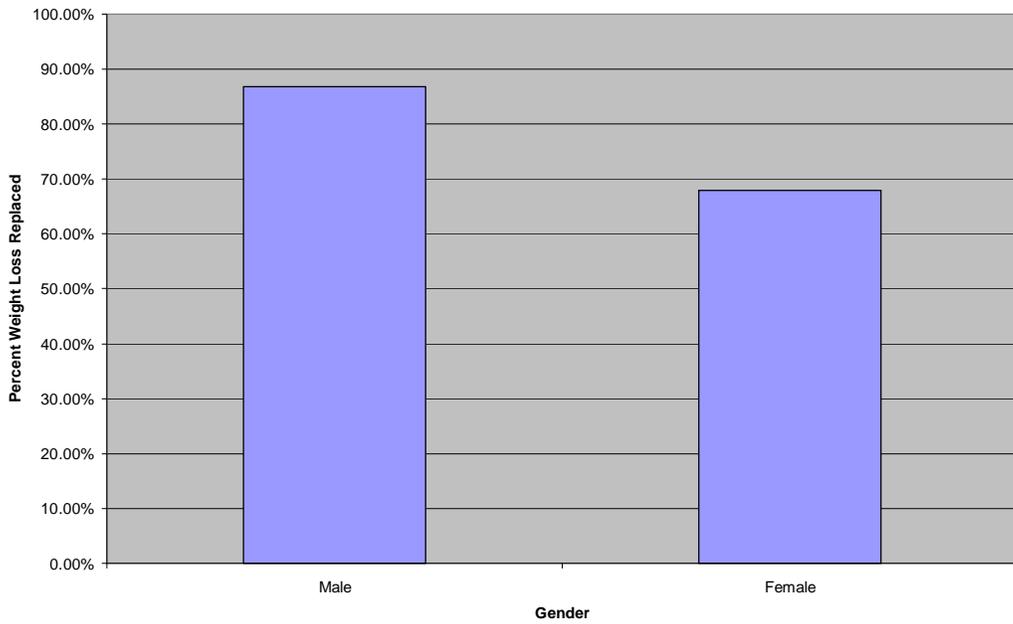
Behavior Score vs. Gender



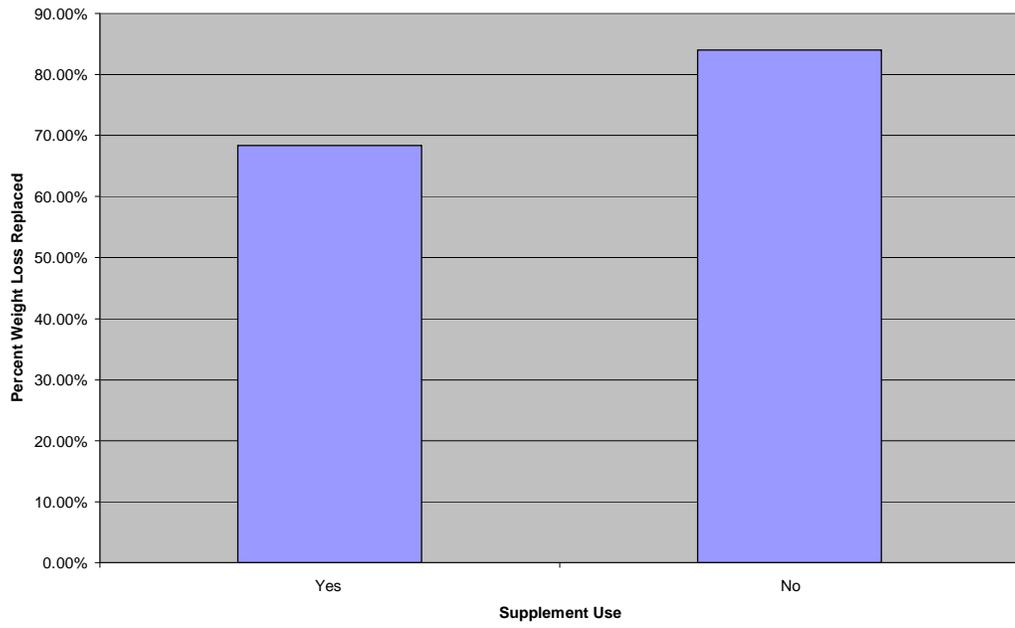
Percent Weight Loss Replaced vs. Team



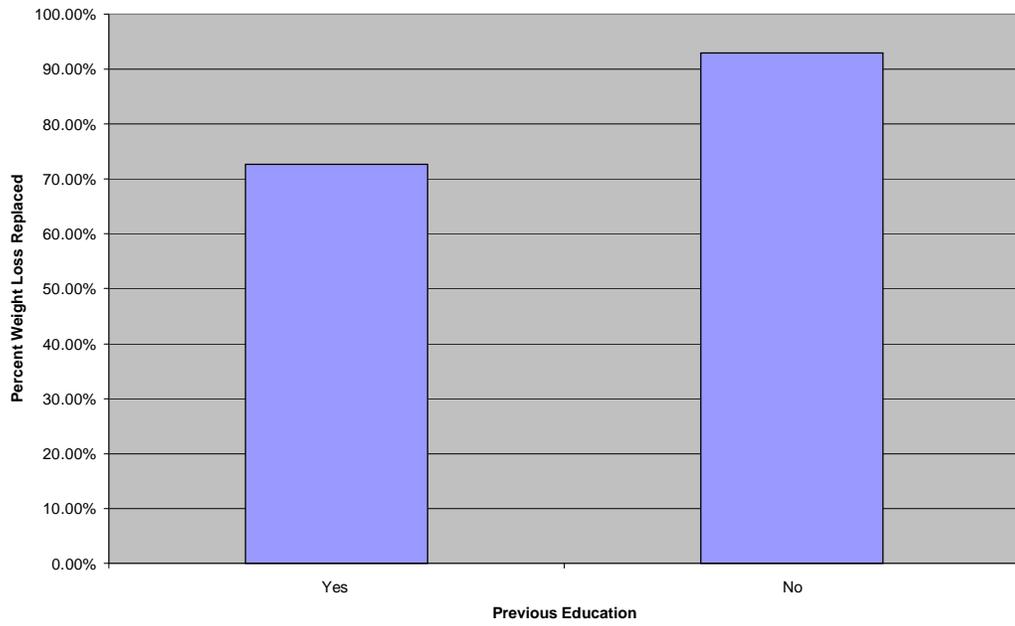
Gender vs. Percent Weight Loss Replaced



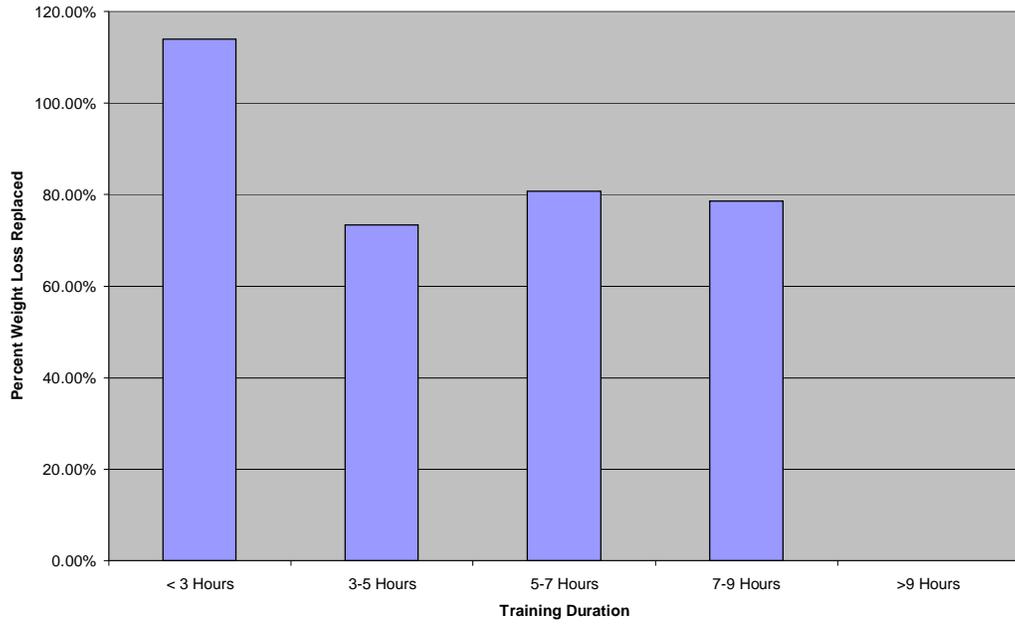
Supplement Use vs. Percent Weight Loss Replaced



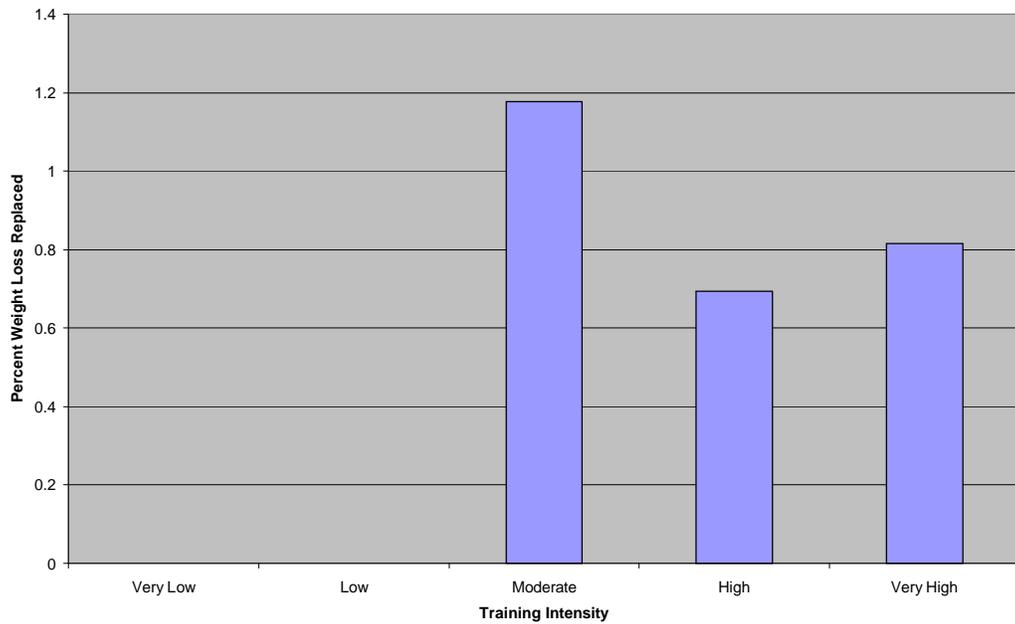
Previous Education vs. Percent Weight Loss Replaced



Training Duration vs. Percent Weight Loss Replaced



Training Intensity vs. Percent Weight Loss Replaced



Appendix C

Correlation Coefficients for Survey and Weight Chart Data

Females

Variable	% Weight Loss Replaced	Knowledge Score	Attitude Score	Behavior Score	Total Score
% Weight Loss Replaced	1	0.19901 P=0.3197	0.09818 P=0.6332	-0.15111 P=0.4518	0.06812 P=0.7356
Knowledge Score	0.19901 P=0.3197	1	0.50910 P=0.0079	0.30572 P=0.1209	0.49620 P=0.0085
Attitude Score	0.09818 P=0.6332	0.50910 P=0.0079	1	0.38405 P=0.0527	0.94228 P<.0001
Behavior Score	-0.15111 P=0.4518	0.30572 P=0.1209	0.38405 P=0.0527	1	0.58478 P=0.0014
Total Score	0.06812 P=0.7356	0.49620 P=0.0085	0.94228 P<0.0001	0.58478 P=0.0014	1

Males

Variable	% Weight Loss Replaced	Knowledge Score	Attitude Score	Behavior Score	Total Score
% Weight Loss Replaced	1	0.14044 P=0.4433	0.32371 P=0.0707	-0.05923 P=0.7475	0.28403 P=0.1152
Knowledge Score	0.14044 P=0.4433	1	0.05233 P=0.7761	-0.05469 P=0.7662	0.34484 P=0.0533
Attitude Score	0.32371 P=0.0707	0.05233 P=0.7761	1	0.46078 P=0.0080	0.92600 P<0.0001
Behavior Score	-0.05923 P=0.7475	-0.05469 P=0.7662	0.46078 P=0.0080	1	0.60953 P=0.0002
Total Score	0.28403 P=0.1152	0.34484 P=0.0533	0.92600 P<0.0001	0.60953 P=0.0002	1

All Athletes

Variable	% Weight Loss Replaced	Knowledge Score	Attitude Score	Behavior Score	Total Score
% Weight Loss Replaced	1	0.12066 P=0.3627	0.20560 P=0.1216	-0.10748 P=0.4178	0.15809 P=0.2318
Knowledge Score	0.12066 P=0.3627	1	0.16212 P=0.2241	0.04258 P=0.7488	0.36521 P=0.0045
Attitude Score	0.20560 P=0.1216	0.16212 P=0.2241	1	0.43768 P=0.0006	0.93129 P<0.0001
Behavior Score	-0.10748 P=0.4178	0.04258 P=0.7488	0.43768 P=0.0006	1	0.59477 P<0.0001
Total Score	0.15809 P=0.2318	0.36521 P=0.0045	0.93129 P<0.0001	0.59477 P<0.0001	1

Cronbach's Alpha

Variables	Mean	Standard Deviation	Raw	Standardized
Knowledge	17.5405405	1.9102405	0.195273	.
Attitude	84.0135135	9.0136780	0.706629	0.768759
Behavior	13.9864865	2.7121909	0.615948	0.645502

REFERENCES

- Askew, E.W. (1995). Environmental and physical stress and nutrient requirements. *The American Journal of Clinical Nutrition*, vol. 61(suppl), pg. 631-637.
- Askew, E.W. (1998). Nutrition and performance in hot, cold, and high altitude environments. In I. Wolinsky (Ed.), *Nutrition in Exercise and Sport* (pp. 597-619). Boston, MA: CRC Press LLC.
- Casa, D.J. (1999). Exercise in the heat. I. Fundamentals of thermal physiology, performance implications, and dehydration. *Journal of Athletic Training* vol. 34(3), pg. 246-252.
- Casa, D.J. (1999). Exercise in the heat. II. Critical concepts in rehydration, exertional heat illnesses, and maximizing athletic performance. *Journal of Athletic Training* vol. 34(3), pg. 253-262.
- Casa, D.J., Armstrong, L.E., Hillman, S.K., Montain, S.J., Reiff, R.V., Rich, B.S.E., Roberts, W.O., & Stone, J.A. (2000). National Athletic Trainers' Association Position statement: Fluid replacement for athletes. *Journal of Athletic Training* vol. 35(2), pg. 212-224.
- Cheuvront, S.N. (2005). Hydration assessment of athletes. *Sports Science Exchange*, vol. 18(2), pg. 1-10.
- Convertino, V.A. (1991). Blood Volume : its adaptation to endurance training. *Medicine and Science in Sports and Exercise*, vol. 23, pg 1338.
- Coris, E.E., Ramirez A.M., & Van Durme D.J. (2004). Heat illness in athletes: the dangerous combination of heat, humidity and exercise. *Sports Medicine*, vol. 34(1), pg. 9-16.
- Coyle, E.E.. (1994). Fluid and carbohydrate replacement during exercise: How much and why? *Sports Science Exchange*, vol. 7(3), pg. 1-9.
- Ferry, M. (2005). Strategies for ensuring good hydration in the elderly. *Nutrition Reviews*, vol. 63(6), pg. 22-29.
- Finn, J.P. & Wood, R.J. (2004). Incidence of pre-game dehydration in athletes competing at an international event in dry tropical conditions. *Nutrition and Dietetics* 61(4), pg. 221-225
- Godek, S.F. (2005). Hydration status in college football players during consecutive days of twice-a-day preseason practices. *American Journal of Sports Medicine*, vol. 33(6), pg. 843-851.

- Grandjean, A. & Campbell, S.M. (2004). Hydration: Fluids for Life. International Life Science Institute Monograph Series.
- Grandjean, A.C., Reimers, K.J., & Buyckx, M. E. (2003). Hydration: Issues for the 21st Century. *Nutrition Reviews*, vol. 61(8), pg. 261-271.
- Institute of Medicine (2004). Dietary Reference Intakes for water, potassium, sodium, chloride, and sulfate. Washington, DC: The National Academies Press, in press.
- Jung, A.P. (2005). Influence of hydration and electrolyte supplementation on incidence and time to onset of exercise-associated muscle cramps. *Journal of Athletic Training* vol. 40(2), pg. 71-75.
- Kenney, W.L.. (2004). Dietary water and sodium requirements for active adults. *Sports Science Exchange*, vol. 17(1), pg. 1-8.
- Maughan, R.J.. (1997). Preparing athletes for competition in the heat: developing an effective acclimation strategy. *Sports Science Exchange*, vol. 10(2), pg. 1-7.
- Maughan, R.J.. (1996). Rehydration and recovery after exercise. *Sports Science Exchange*, vol. 9(3), pg. 1-8.
- McCardle, W.D., Katch, F.I., & Katch, V.L. (1996). *Exercise Physiology: Energy, Nutrition, and Human Performance*. Baltimore, MD: Williams and Wilkins
- Murray, R. (1998). Fluid needs of athletes. In J. Berning & S.N. Steen (Eds.), *Nutrition for Sport and Exercise* (pp. 143-153). Boston, MA: Jones and Bartlett Publishers.
- Murray, R. (1996). Dehydration, Hyperthermia, and Athletes: Science and Practice. *Journal of Athletic Training* vol. 31(3), pg. 248-252.
- Nichols, P.E., Jonnalagadda, S.S., Rosenbloom, C.A., & Trinkaus, M. (2005). Knowledge, Attitudes, and Behaviors Regarding Hydration and Fluid Replacement of Collegiate Athletes. *International Journal of Sport Nutrition and Exercise Metabolism*, vol. 15, pg. 515-527.
- Oppliger, R.A. & Bartok, C. (2002). Hydration Testing of Athletes. *Sports Medicine*, 32(15), pg. 959-971.
- Puhl, S.M. (1998). Nutrition and performance in hot, cold, and high altitude environments. In I. Wolinsky (Ed.), *Nutrition in Exercise and Sport* (pp. 277-314). Boston, MA: CRC Press LLC.
- Rehrer, N.J. (2001). Fluid and Electrolyte Balance in Ultra-Endurance Sport. *Sports Medicine*, 31(10), pg. 701-715.

- Rocker, L., Kirsch, K.A., Heyduck, B., & Altenkirch, H.U. (1989). Influence of prolonged physical exercise on plasma volume, plasma proteins, electrolytes and fluid-regulating hormones. *International Journal of Sports Medicine*, 10, pg. 270.
- Sawka, M.N., Cheuvront, S.N., & Carter R. (2005). Human Water Needs. *Nutrition Reviews*, 63(6), pg.30-39.
- Senay, L.C. (1998). Water and Electrolytes During Physical Activity. In I. Wolinsky (Ed.), *Nutrition in Exercise and Sport* (pp. 257-276). Boston, MA: CRC Press LLC.
- Senay, L.C. & Pivarnik, J.M. (1985). Fluid shifts during exercise. Terjung, R.L. (Ed.) *Exercise and Sport Sciences Reviews*, 13 New York, MacMillan.
- Shirreffs, S.M.. (2004). Fluid and electrolyte needs for preparation and recovery from training and competition. *Journal of Sports Sciences*, vol. 22, pg. 57-63.
- von Duvillard, S.P., Braun, W.A., Markofski, M., Beneke, R., & Leithäuser, R. (2004). Fluids and Hydration in Prolonged Endurance Performance. *Journal of Nutrition*, vol. 20(7/8), pg. 651-656
- Wetherall, K.. (2003). Nutrition Notes. Hot time in the summertime: hydration and athletic performance. *Athletic Therapy Today*, vol. 8(4), pg. 51-53.
- Whitney, E. & Rolfes, S.R.. (2005). *Understanding Nutrition*. Belmont, CA: Wadsworth